A
HISTORY
OF
HEMISTRY

J. R.
ARTINGTON

VOLUME
FOUR

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A HISTORY OF CHEMISTRY

BY

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VOLUME ONE

Part I: Theoretical Background

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PROFESSOR J. R. PARTINGTON

OBITUARY

PROFESSOR James Riddick Partington, M.B.E., who occupied the Chair of Chemistry at Queen Mary College from 1919 to 1951, was well known throughout the world for his outstanding encyclopaedic and erudite contributions to the history of chemistry; for his textbooks and treatises on various aspects of physical and inorganic chemistry; and for his earlier experimental research on gases.

Partington was born at Bolton, Lancashire, on June 20, 1886 and was educated at the University of Manchester, where he obtained first-class honours in chemistry and subsequently became a university scholar and Beyer Fellow. He was one of the group of brilliant chemists emerging from the University of Manchester at this time and contemporaries or near-contemporaries included Professor W. N. Haworth, F.R.S., and Sir Robert Robinson, F.R.S. During his immediate postgraduate period Partington carried out research in Lapworth's laboratory and later held an 1851 Exhibition scholarship during the tenure of which he studied under Nernst in Berlin, who attracted at this time a number of English scientists including F. A. Lindemann (later Lord Cherwell). This period clearly had a great influence on his mind. In later life he painted a vivid verbal picture of his memories of Planck sitting along with porters in rather rough dress, large dogs and other livestock in his third-class compartment carefully reading his notes on the way to his morning lecture.

PURIFICATION OF WATER

On his return to England in 1913 Partington was appointed a Lecturer in Chemistry at Manchester. His career was, of course, interrupted by the war, during which he carried out investigations for the Ministry of Munitions in association with E. K. (later Sir Eric) Rideal on the purification of water and the oxidation of nitrogen. There was a distinctly military aspect to his otherwise predominantly unassuming and gentle character. His war work was recognized by the award of the M.B.E. (Military Division). Towards the end of his life he was to produce a volume on *A History of Greek Fire and Gunpowder* with a preface by Lieutenant-General Sir Frederick Morgan, K.C.B.

During his period in Berlin Partington worked with Nernst on the specific heats of gases and this was undoubtedly the origin of what was to be his chief experimental work, carried out after his appointment to the Chair of Chemistry

at Queen Mary College in 1919 at the early age of 33. Partington's contribution to the study of specific heats led to the publication in 1924 of a book on this subject with his collaborator Shilling. The late Sir Ralph Fowler in his *Statistical Mechanics* pays considerable attention to Partington's results and to his historical sense in the appreciation of the significance and value of earlier work in the field.

Already (1921) Partington was writing prolifically, at first for students, and his *Inorganic Chemistry* is justly famous, running in the course of time through six editions. Now out of favour for various reasons, this book was undoubtedly one of the best texts of its time and has a successor, *General and Inorganic Chemistry* (1946), of which a new (fourth) edition is in the press. However, the major contributions which Partington was to make to the dissemination of chemical knowledge lay in two entirely distinct fields, physical chemistry and the history of chemistry.

Between 1949 and 1954 his *Advanced Treatise on Physical Chemistry* appeared in four large volumes totalling some one-and-a-half-million words. This work received high praise for the astonishing encyclopaedic knowledge it displayed and for the way in which it was likely to influence the teaching and practice of its subject. Undoubtedly Partington will be remembered for this work; but as the subject advances the treatise will no doubt become out of date.

Incomplete Manuscript

This is unlikely to happen to his quite outstanding contributions to the history of chemistry for which he is justly renowned. His first major work in this field was the monumental *Origins and Development of Applied Chemistry* (1935), essentially a study of the prehistory of chemistry and the chemical arts in the older civilizations and containing over 25,000 documentary references. He himself had grave doubts as to whether the appearance of this volume would be 'timely' or even 'significant' (a typical touch of irony) and it was only after urgent encouragement from E. O. von Lippmann that plans for publication went forward. The *Origins and Development* was succeeded in 1937 by a *Short History of Chemistry*, the forerunner to his *magnum opus A History of Chemistry*, volumes II, III and IV of which have now been published. About one-third of volume I is believed to have been set in type. Unfortunately the final stages of the manuscript were incomplete at the time of his death. This remarkable work with its stupendous documentation is unique and likely to remain so for a very long time as a vast mine of information for future historians of chemistry.

As a man Partington was intensely reserved, but with a dry sense of humour which peeped out from the prefaces to some of his works, but which otherwise was apparent only to those who knew him rather well. It must be admitted that he was also capable of some acerbity and asperity of manner. His mental attributes were noticeably teutonic; he quotes with obvious approval an anonymous comment about Thomas Young that 'the ample pages of the

Encyclopaedia Britannica provided a fitting storehouse for arranging the treasures of his truly encyclopaedic mind, and an opportunity of allaying that thirst for labour which haunted him throughout life as a passion'. Many will mourn the death of this great scholar of chemistry.

Partington served on the Council of the Chemical Society from 1922 to 1925. His scholarship as an historian of his subject while not widely appreciated in his time, gained for him the Dexter Award of the Division of the History of Chemistry of the American Chemical Society (1961); and shortly before his death he was greatly pleased to receive the award of the Sarton Medal of the American History of Science Society. He was the first Chairman of the Society for the Study of Alchemy and Early Chemistry at its foundation in 1937 and President of the British Society for the History of Science (1949–51).

The Times, October 11th, 1965

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CHEMISTRY AS RATIONALISED ALCHEMY

Presidential Address to the British Society for the History of Science delivered by the late Professor J. R. Partington, M.B.E., on 7th May 1951

WHEN, towards the end of his life, Plato came to write the *Timaeus* he attempted to cover in it the whole scope of created being. After first describing, without conscious difficulty, the origins of the gods and of the heavens, of man and of animals, he comes at last to what is, in effect, the first treatise on theoretical chemistry, for he sets himself the task of the investigation of the nature and affections of the four elements. The dialogue, or more correctly and as often the case with Plato, the monologue, is here conducted, not by Socrates or a member of the school of Plato, but by Timaeus, a Pythagorean. At this point the soaring confidence of the narrative falls to a minor key; the things are difficult, we are to expect only probabilities, and the subject is begun again on this basis. In considering the nature of gold, for example, we might explain it in terms of that division of space into the kinds of triangles which was competent earlier in the treatment to explain so much, but here, says Plato, 'it would be by far the safest and most correct to say that it is gold'.

From the very beginning, then, we find that the study of the composition of things is treated as somewhat apart from other branches of learning; its methods are different, and in this study we must 'begin again'.

The origins of chemistry, as you well know, are remote and very obscure. In the earliest treatises on the subject, which is there appropriately named the 'divine art', it takes a shape which, at first sight, has little relation to its modern form. In the earlier centuries of the Christian Era, probably in Alexandria and very likely in small, obscure, bodies of students, perhaps with gnostic affinities, a subject completely unlike anything which had preceded it in Greek or Roman learning, came into being. Its sources are only partly Greek and it seems unlikely that its study ever formed a part of the activities of the Museum, or that its works were on the shelves of the great Library. Its most copious author is Zosimos of Panopolis, who is described by a commentator as 'the crown of the philosophers, whose language has the abundance of the ocean'. Zosimos gives a definition of chemistry (an alternative name used for the divine art). It is the science which treats of 'the composition of waters, movement, increase, taking away and restoration of bodily nature, fixation of spirit on body; the operations of which do not result from the addition of foreign natures taken from without but are due to the proper and unique nature active upon itself, derived from a single species; also the earthy part of metals and the juices of plants; and all this unique and many-coloured system

comprises the multiple and very varied discourse of, and research into, the sublunar things of nature, subject to the measure of time, through which nature suffers decay and renews itself continually'.

Zosimos gives us some practical information, but also some remarkable visions which he had, and the earliest chemistry, and the alchemy which for many centuries was its lineal descendant, offer a strange blend of the practical and the visionary. Besides the description of chemical apparatus and of many new substances not mentioned by earlier writers, we find much of rather obscure and semi-mystical nature, but nothing which would technically be called magic or the black art. The popular exponents of alchemy never fail to adorn themselves, at least metaphorically, in a pointed cap, and would have us believe that alchemy was a branch of magic and largely a matter of hocus-pocus. In actual fact the early treatises are devoid of material of this kind, so fully known in the contemporary magic papyri. There are sometimes dramatic accounts of the finding of books concealed in altars, and the invocation of shades, and the like, but it may well be that this is based on contemporary fiction and added for the sake of effect.

Be this as it may, alchemy always contained a mystical or semi-mystical element. In some cases, as in the attribution of life to what we now think of as inanimate things like metals, which were thought capable of growing like plants and putting forth flowers of diverse colours — forming salts we should say — this view was a commonplace of its time. Just as a seed of wheat put into the earth was thought to die and suffer corruption, and from this dead matter a new life was to arise, so it was thought that if a metal could be killed and its proper nature taken away, its corrupt or primary matter, could, by suitable treatment, like watering the ground, bring it to life in a more perfect form: copper would shine in the splendour of silver or the solar effulgence of gold.

Through the centuries alchemy was studied by great men like Roger Bacon and Albertus Magnus. St. Thomas Aquinas asks whether alchemical gold can lawfully be given as real gold, and affirms that it can if its nature is that of gold; in fact, as Plato would have said, if it is gold.

Alchemy, which Albertus Magnus called the 'beggardly union of genius and fire', was turned to the service of medicine by Paracelsus, who taught the doctrine of the three alchemical elements, mercury, sulphur and salt. Rather later, Van Helmont, who rejected these and taught that the true elements are air and water, made the first steps towards the founding of chemistry by ridding alchemy of some of its irrational elements, by performing quantitative experiments, and by inventing the new name 'gas' for air-like bodies with properties different from those of ordinary air. With Van Helmont, who died in 1644, we are very near the true beginning of scientific chemistry.

Professor Dingle, in a recent lucid survey of the significance of science, has said that: 'The lines on which science has proceeded since the early seventeenth century were laid down by Galileo and his successors'. He points out that they postulated that the ultimate data for scientific study are our experiences, which form the subject-matter of the various sciences of mechanics,

calorimetry, optics, acoustics and the rest. Professor Dingle presumably intends chemistry to be included in the rest, and this is no doubt true if we admit that we obtain knowledge of chemical composition through the senses. Whilst, however, the sense of sight is related to optics, the sense of sound to acoustics, and so on, there is no corresponding chemical sense (if we exclude the sense of smell as not covering all cases). I am not capable of giving any account of the philosophical aspects of the subject, which it would be worth your time to listen to, but I intend to invite your attention to the proposition that the development of chemistry followed a rather different line from that envisaged by Professor Dingle for the physical sciences, that it owed little or nothing to Galileo, and that the peculiar and complex mode by which chemistry came into being and still progresses, is one which has been neglected by some historians of science more concerned with the origins and development of mathematics, astronomy, and biology.

Chemists have reason to think that the modern trend of their science began with Robert Boyle a little later than Galileo, and if they wish to know if Boyle was guided by any philosophical ideas they have not far to seek, since he himself tells us in so many words that in his method he followed the precepts of a philosophical thinker who is not mentioned by Professor Dingle, nor for that matter by many modern writers, namely Francis Bacon. I am aware of the severe judgments passed on Bacon by many critics, mostly continental, and it is no part of my intention to enter this controversial field. I wish merely to say that Bacon is named as an originator of chemical method, that he does in fact include chemistry among the sciences which must be taken into account in forming an adequate picture of the knowledge of his time, and that he recognised that in this field he was following a long tradition. He realised that chemistry could never hope to develop from a few postulates or laws, which by mathematical methods could lead to consequences which could be tested by experiment, but that it was something more complex and difficult. He recognised that the only workers who had, in his time, anything significant to say about chemistry were the chemists, or as they were then called, the alchemists, and that if progress was to be made in this field it must start with what the experts, the alchemists, had already established, and not from abstract postulates or laws taken over from entirely different fields. Chemistry, he realised, if it was to become a science, would have to be rationalised alchemy.

I have no time to give the passages in Bacon's writings which justify my thesis, but I may direct your attention to the statement of Robert Hooke, who says that 'the incomparable Verulam' had shown that 'even Physical and Natural Enquiries as well as Mathematical and Geometrical, will be capable also of Demonstration; so that henceforward the business of Invention will not be so much the Effect of acute Wit, as of a serious and industrious Prosecution'. The distinction drawn by Hooke seems to me significant from the high place he took among those who made important contributions to the development of chemical science in his time. It has been pointed out that most of Bacon's important works on the 'advancement of learning' were

written in the early years of the seventeenth century, when the main discoveries known to him, such as Gilbert's and Harvey's, were non-mathematical, and the few mathematical works available to him were very specialised. Neither Kepler's laws nor Galileo's laws of falling bodies were known. Of contemporary chemical writings, Bacon shows a competent knowledge. He mentions Paracelsus often, and refers to Isaac Holland and Basil Valentine, long regarded by chemical authorities with great respect. The alchemical-theosophical background of much of Bacon's work was firmly grounded in contemporary England but much more prominent in Germany.

Bacon made chemical experiments himself and his book, *Sylva Sylvarum*, although it has been much derided, was probably the best and most complete collection of its kind available at the time. He was fully aware of the weakness of alchemical practice, saying, for example, that the alchemist fails in 'the true proportions and scruples of practice, which makes him renew his trials infinitely and, finding that he lights upon some mean experiments and conclusions on the way, feeds upon them, magnifies them to the most, and supplies the rest in hopes,' adding: 'not but that the alchemists have made a good many discoveries and presented men with useful inventions'. He says the development of this science will more probably be effected by 'a diligent study of the natures of weight, colour, malleability and extension, volatility and fixedness, and of the first seeds and menstruums of minerals, than that a few grains of an elixir should in a few moments turn other metals into gold'.

Bacon was more sceptical of the possibility of alchemy than were Boyle and Newton, both of whom were aware that there was no proof, mathematical or otherwise, of the impossibility of transmutation.

We might surmise that, if Newton had applied his powerful mind to chemistry he would have made advances in that science which could have linked up with the epoch-making work of Lavoisier without the necessity of the slow progress and decline of the theory of phlogiston during the eighteenth century. Yet Newton did apply himself to chemistry, and most assiduously, and the results of his arduous labours were practically negligible. Few historians of chemistry find it necessary to mention Newton at all, and in the history of that science he fills a very modest place. Attempts to extend the theory of attraction to chemistry, and thus put this subject on a mathematical basis, were made by John Keill, who in 1708 stated 30 theorems of the laws of attraction in chemistry; and John Freind in lectures at Oxford in 1704, published in 1709, explained chemical actions on the same principles. These theoretical extensions of Newton's methods were almost without influence on the progress of chemistry. On the experimental side, Hales carried out a long series of measurements of the quantities of air extricated in many chemical processes, and by his neglect of what the meanest alchemist would have noticed in the qualities of the materials he had collected. Hales missed important discoveries which many years later were to make the name of Priestley immortal. Even Newton could make no progress without a knowledge of new substances, and these could not be discovered by the use of such methods as had weighed the heavenly bodies and inaugurated a science of mathematical

astronomy without parallel in the great achievements of all ages. Prof. Singer has said that Galileo announced the proposition that 'science is measurement', but chemistry is a science and it is not all measurement.

The great discoveries in chemistry in the eighteenth century, made by Scheele and Priestley, lay in a field amenable only to the use of the chemical method of investigation. The main features of it were well-known to the alchemists. Materials of all kinds were subject to fire, to acids, to unlikely trials; and from this series of experiments there emerged the new gases, which had been in the hands of chemists before but had not been clearly recognised. It was from this material that Lavoisier was to construct a new science.

Before turning to Lavoisier's contributions I would like to digress for a few moments to consider another matter which is of some importance to us as members of a society concerned with the welfare of the history of science. Some of us may forget at times that there is in existence a deep hostility to the study of that subject. We are made aware of this in many ways. The hostility is noticeable among some teachers in schools, who dislike books which touch upon the historical aspects of their subjects. In the universities we find that the subject of the history of chemistry has disappeared from the syllabus for the degree. When this happened, we were told that the time had come when chemistry must be treated on didactic lines, that the growth and complexity of the science were such that all the energies of students were absorbed in mastering the present state of the science, and that any mention of its origins was not only a waste of time but also could only confuse and repel the student approaching the subject. Although it was seemly and useful to point out the achievements of contemporary chemists, the contributions of their predecessors, outmoded as they were, could well be treated as integral parts of a science which had now reached a stage of development not requiring any enquiry into its remote origins. This view has not been shared by all. Richard Willstätter, for example, emphasised the value of teaching chemistry on an historical basis, even going so far as to say that this method might differentiate its study in a university from that in the more hurried and less fundamental treatment suited to a technical school; but the majority seem to have little sympathy with any study of its history: I believe this attitude goes back at least to Lavoisier. In the *Traité de Chimie* (1789), one of the great historical documents of chemistry, to which the development of the science in the first part of the nineteenth century owes so much, we find it prominent.

In the preface, Lavoisier says he might be reproached with having given no history of the opinions of his predecessors and only presented his own. In an elementary treatise, however, such a long and tedious account would tend to obscure the true object proposed and produce a work the reading of which would be tedious to beginners. The sciences are already difficult enough without bringing in matter foreign to them, and in the interests of clarity everything must be carefully avoided which might distract the attention. It would take at least three or four years of study to learn even the elements of the science, without unnecessary additions. If he had frequently adopted the opinions of his French contemporaries without mentioning their names, this

was because they all formed, as it were, a community in which it might be difficult to distinguish what belonged to any individual. The sole method of sound treatment is to preserve only facts given by nature and to seek truth only in the natural sequence of experiments and observations, in the same way as the mathematicians arrive at the solution of a problem. It is with some surprise, therefore, that we find that the book opens with a discussion of caloric, the fluid and material basis of heat, the existence and properties of which are developed by a series of superficial analogies of the soaking up of water by sponges or woods, and the expansive properties of gases are explained by the self-repulsive properties of the caloric existing between their particles. Francis Bacon had hit on the correct nature of heat, perhaps not in a way giving satisfaction to some, but still a way giving a correct result, and an old-fashioned teacher of Lavoisier's time might, in an historical digression, have mentioned this, at the same time pointing out that the idea that heat is a form of motion had been discarded by the modern leaders of the science. Lavoisier says: 'We cannot too much help ourselves in abstract things by comparisons with sensible', and hence the water-soaked sponge helps us to reach the view taught throughout the book that heat is a material fluid. He says: 'There is a real repulsion between the molecules of elastic fluids', adding as an afterthought, 'or at least things behave as if this repulsion occurs'. The old-fashioned teacher might have added, as a curiosity, that some had thought the particles of gases did not repel one another, and that Bernoulli in 1738 had shown that the physical properties of gases could be quantitatively explained in terms of the kinetic energies of their non-repulsive particles. In his book Lavoisier, although not often mentioning others, rarely omits to say what he has done. In the section on combustion he begins by saying that in it: 'there is hardly anything which is not my property, either because I did it first or because I repeated it under a new point of view'. Oxygen gas is: 'this air which we, Mr. Priestley, Mr. Scheele and I discovered about the same time', the necessity for brevity in an elementary work leading him to omit the passage in one of his memoirs to the effect that Priestley had discovered the gas 'about the same time as I, and I believe even before me'.

The *Traité de Chimie* many times claims to be a much better work than any which preceded it, and in some respects it undoubtedly is. In the introduction to the practical part Lavoisier says it is a mistake to fill an elementary work with minute descriptions of apparatus and illustrations, 'which interrupt the flow of ideas and make the reading tedious and difficult'. He gives us, nevertheless, a very detailed description of a gasometer which few apart from Lavoisier could afford to have constructed and which, all the same, gave him less accurate results on the composition of water than Cavendish achieved with much less elaborate apparatus. There is a modern ring in Lavoisier's words: 'It is an inevitable effect of the stage of perfection which chemistry now begins to approach, of requiring costly and complicated instruments and apparatus'. He also lacked the flexibility of mind of Priestley, saying, for example in respect of an opinion which he had been forced to give up: 'It will be appreciated how much it has cost me to give up my first ideas; it is

only after many years of reflexion and after a long sequence of experiments and observations . . . that I have decided to do so'.

I have introduced this digression with no intention of belittling such a man as Lavoisier. The historian of science can, however, find many things which can have a significance in his own time.

Let us now return to our main subject. It has often been said that Lavoisier introduced the quantitative method into chemistry, but everyone here will know that this is not true. The quantitative method had been used by Van Helmont with success, by Hales without success, and by Black with great success in a limited field. Lavoisier's quantitative method succeeded because it had many more materials to work upon than were available previously. The new gases discovered by Priestley made all the difference, and these were discovered by purely chemical methods, no use being made of any methods derived from astronomy, or physics, or mathematics. With these discoveries, Lavoisier was able, by the use of methods derived from physics and mathematics, to transform chemistry, and he was the first great physical chemist.

It was Davy, no slavish follower of Lavoisier and undoubtedly the most imposing and significant figure in chemistry in the opening years of the nineteenth century, who said that Lavoisier's chemical system lacked completeness even for its time. It took no account of such things as the laws of combining proportions, a subject which had received attention by Homberg, Bergman, Cavendish, Kirwan and Richter before Lavoisier's book was published. The major work in this field had been carried out by Jeremias Benjamin Richter, who was to continue it until 1807, the same year in which Dalton's atomic theory was announced to the chemical world. Richter was a very good practical chemist, but his main contribution was in theory. He first realised what we now call the law of reciprocal proportions or equivalents in its fuller extent, and he gave tables of chemical equivalents. He failed to impress the contemporary chemists for two reasons. In the first place, a mathematician as well as a chemist, he believed that the numbers representing combining proportions should be subject to mathematical laws and form series. We know that the numbers do not, in fact, follow any such mathematical regularities. Richter felt authorised to alter some of the numbers in order to make them fit into the series, and chemists very naturally refused to follow him. In the second place, Richter failed to notice that his numerous tables could be greatly simplified by adopting a single element as the basis of the series of equivalents, and as soon as this was done by Fischer in 1802, Richter's work became appreciated through the description of it given in Berthollet's *Statique Chimique* in 1803. By the time this book reached England, Dalton had given his first table of atomic weights at a meeting of the Manchester Literary and Philosophical Society, and his atomic theory was not due to any influence by Richter. Dalton was also a mathematician. He seems to have arrived at the chemical atomic theory through a combination of Newton's theory that gaseous pressure is due to the repulsion of the particles of gases with the theory that these particles are surrounded by envelopes of caloric of various sizes. Both these assumptions are erroneous, and once Dalton had appreciated the

possibility of atoms differing in weight he proceeded on the lines of experiments on chemical combining proportions, as had been done by Richter.

Perhaps the most striking example of the relation of physical to chemical methods is furnished by the development of the law of mass action. Throughout the eighteenth century the idea that chemical changes were due to the action of forces between particles was held. Geoffroy in 1718 arranged substances in a table of affinities, but as (so I have seen somewhere) the Paris Academy did not favour Newton's name 'attraction', he used the name 'rapport', which with the derivation *ratio*, λόγος, might lead us to the Stoic idea of force. Generally, however, it was believed that affinity should be explained as due to modified gravitational attraction, although Newton himself had not favoured this idea. A substance AB, say a salt of an acid A and a base B, is decomposed by another substance C, say another acid, to form BC with liberation of A because the attraction of B and C is greater than that of A and B. Bergman in 1775 and Berthollet in 1801 both started with the same idea of affinity as universal attraction, but reached diametrically opposed results. Bergman supposed that the decomposition would be complete, affinity acting as what was called an absolute force, whilst Berthollet thought it should be incomplete, the result of an equilibrium of forces, modified by such forces as the elasticity of gases or the cohesion of solids. That the same theory can lead to two incompatible results shows that it has nothing to do with the matter. After a long series of chemical investigations it became clear that gravitational attraction cannot help in the study of chemical changes. The law of mass action is a law in the formulation of which the idea of force does not enter. It is a chemical law in the sense that it is a quantitative statement of chemical phenomena. Many chemists may feel that it is better left as it is, and can derive satisfaction from a generalisation of such wide applicability.

Chemists should always be interested in the attempts of mathematicians and physicists to explain the fundamental laws of chemistry which have been arrived at by methods peculiar to the science, but if they are wise they will continue to use these laws, and feel satisfaction in them, even though they cannot yet be reduced to terms of concepts which seem rather foreign to the content of chemistry.

At various times we find the physical sciences dominated by particular aspects of belief, and chemistry has necessarily been influenced by these. In the period of alchemy, the notions of primary matter and substantial forms were predominant. In the seventeenth century atomism began to penetrate the science, in the eighteenth century it was hoped that the idea of universal attraction could be extended to include chemical phenomena, in the nineteenth century energy, and in the twentieth the quantum theory. All these are still insufficient to cover the whole science, which goes its way to new discoveries made by its own methods.

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JOURNALS, COLLECTIONS, ABBREVIATIONS

A. Med. Archiv für die Geschichte der Medizin, ed. K. Sudhoff, Leipzig, 1908 f.

A. Nat. Archiv für die Geschichte der Naturwissenschaften und der Technik, Leipzig, 1909 f.

A. Phil. Archiv für die Geschichte der Philosophie.

A. Rel. Archiv für Religionswissenschaft, Freiburg i/B, 1898 f., Leipzig, 1904 f.

Abhl. Akad. Berlin, phil.-hist. Kl. — *see Abhl. Preuss. Akad.* . . .

Abhl. Akad. Munich, Philos.-philol. Cl. (——*phil.-hist. Abt.*). Abhandlungen (Sitzungsberichte) der Akademie der Wissenschaften zu München, Philosophisch-philologischen Classe (philosophisch-historischen Abteilung).

Abhl. K. Ges. Wiss. Göttingen. Abhandlungen der Königlichen Gesellschaft der Wissenschaften zu Göttingen.

Abhl. Munich. Akad. Abhandlungen der königlichen Bayerischen Akademie der Wissenschaften, Munich.

Abhl. Preuss. Akad., phil.-hist. Kl. Abhandlungen der Preussischen Akademie der Wissenschaften (Berlin), philosophisch-historisch Klasse.

Abhl. Sächs. Ges. Wiss., Phil.-hist. Kl. Abhandlungen der Sächsischen Gesellschaft der Wissenschaften, Philologisch-historischen Klasse, Leipzig.

AH. — *see* Archer-Hind.

Alt. Or. Der Alte Orient, Leipzig.

Amer. J. Philol. American Journal of Philology, Baltimore, 1880 f.

Amer. J. Theol. American Journal of Theology.

ANL. Ante-Nicene Christian Library: translations of the writings of the Fathers down to A.D. 325, ed. A. Roberts and J. Donaldson, 24 vols., Edinburgh, 1867–97.

Ann. Med. Hist. Annals of Medical History, New York.

Ann. Mus. Guimet. Annales du Musée Guimet (Paris), 1880–1935.

Ann. Sci. Annals of Science, 1936 f.

Arch. Orient. Archiv Orientální, Prag, 1929 f.

BEHE. Bibliothèque de l'Ecole des Hautes Etudes.

Beih. a. O. Beiheften zum Alten Orient.

BG — *see* Fabricius, J. A. (1).

BM. British Museum.

BN. Bibliothèque Nationale.

BPM. Beiträge zur Geschichte der Philosophie des Mittelalters, Münster.

BSOS. Bulletin of the School of Oriental Studies.

Bull. Acad. Méd. Bulletin de l'Académie de Médecine.

Bull. Sch. Or. Stud. Bulletin of the School of Oriental (x f. and African) Studies, 1917 f.

Bull. Soc. Antiq. France. Bulletin (et mémoires) de la Société (royale) des Antiquaires de France, 1857 f.

CAH. Cambridge Ancient History, Cambridge: i 1923, ii 1924, iii 1925, iv 1926, v 1927, vi 1927.

CCAG. Catalogus Codicum Astrologorum Graecorum, ed. Cumont *et al.*, Brussels, sev. vols., 1898 f.

CDB — *see* Smith, W. (6).
CE. Catholic Encyclopedia, New York, 15 vols., 1907–12.
Chamb. Ency. Chambers's Encyclopaedia, 15 vols. 1959.
Chem. Ztg. Chemiker-Zeitung, Cöthen.
CHI. Cambridge History of India, Cambridge, 1922 f.
Class. Quart. Classical Quarterly.
Class. Rev. The Classical Review, 1887 f.
CMAG. Catalogue des Manuscrits Alchimiques Grecs, ed. Bidez, Cumont, *et al.*, 8 vols., Brussels, 1924–32.
CMG. Corpus Medicorum Græcorum, Deutsche Akademie der Wissenschaften, Leipzig and Berlin.
CML. Corpus Medicorum Latinorum, Academia Lipsiensis, Leipzig.
Compt. Rend. Acad. Inscr. Comptes Rendus des Séances de l'Académie des Inscriptions et belles-lettres.
CUL. Cambridge University Library.
D. Lit. Ztg. Deutsche Literaturzeitung, 1880 f.
DA — *see* Smith, W. (3).
Dabistān. The Dabistan, or School of Manners, translated from the original Persian, with Notes and Illustrations, by David Shea and Anthony Troyer, 3 vols., Paris, 1843 (the *Dabistān — i Madhāhib*; attrib. to Muhsin Fānī of Kashmīr, *c.* A.D. 1615–70, who lived for some time in India, or to 'Mobed Shah'); refs. are to vol. and page.
DACL. Dictionnaire de l'Archéologie Chrétienne et de Liturgie, ed. F. Cabrol and H. Leclercq, 15 vols., 1903–53.
DBM — *see* Smith, W. (1).
DCB — *see* Smith, W. (5).
DG — *see* Smith, W. (2).
DS. Daremberg, C. V. and Saglio, E. Dictionnaire des Antiquités grecques et romaines, 5 vols., 4°, 1877–1919.
DTC. Dictionnaire de Théologie Catholique, ed. A. Vacant and E. Mangenot, 1903 f.
E. Bibl. Encyclopaedia Biblica.
E. Isl. Encyclopaedia of Islam. 4 vols. and suppl., 1908–38.
E. Jud. Encyclopaedia Judaica, Berlin, 1928 f.
EB. Encyclopaedia Britannica.
EI. Enciclopedie Italiana.
Ency. Islam — *see E. Isl.*
Ency. Ital. — *see* EI.
ERE. Encyclopaedia of Religion and Ethics, ed. J. Hastings, 13 vols., 1908–27.
FHG. Fragmenta Historicorum Graecorum, ed. C. Müller, 7 vols., Paris (Didot), 1841–51, 1870–2.
GCS. Die griechischen christlichen Schriftsteller der ersten drei Jahrhunderte, Leipzig.
GGM. Geographi Graeci Minores, ed. Müller, Paris (Didot), i, 1855.
Glastechn. Ber. Glastechnische Berichte.
Gött. Anz. Göttingische Gelehrte Anzeiger.
Gött. Nachr., phil.-hist. Kl. Nachrichten (von) der Akademie der Wissenschaften zu (in) Göttingen, philologisch-historische Klasse.
HDA. Handwörterbuch des Deutschen Aberglaubens, Berlin and Leipzig, 9 vols., 1927–38.

HGM. Historici Graeci Minores, ed. L. A. Dindorf, 2 vols., Leipzig, 1870–1.
HT — *see* Festugière (2).
Islam. Der Islam, Strassburg etc., 1910 f.
J. Asiat. Journal Asiatique, 1822 f.
J. Chem. Educ. Journal of Chemical Education, Easton, Pa.
J. des Sav. Journal des savans (savants).
J. Egypt. Archaeol. Journal of Egyptian Archaeology.
J. Hellenic Stud. The Journal of Hellenic Studies, 1880 f.
J. Philol. The Journal of Philology, 1868–1920.
J. prakt. Chem. Journal für praktische Chemie, Leipzig.
J. Roman Stud. The Journal of Roman Studies, 1911 f.
J. Theol. Stud. The Journal of Theological Studies.
Jahrb. f. Philol. Jahrbücher für Philologie und Pädagogik, Leipzig, 1826 f.
Jahrb. klass. Philol. Jahrbücher für klassische Philologie und Pädagogik.
JE. Jewish Encyclopedia, ed. C. Adler *et. al*., New York, 12 vols., 1901–6.
JRAS. Journal of the Royal Asiatic Society.
Jud. Lex. Jüdisches Lexikon, ed. G. Herlitz and B. Kirschner, 5 vols., 1927–30.
LS. Lewis, C. T., and Short, C. A Latin Dictionary, Oxford, 1951.
LSJ. Liddell, H. G., Scott, R. A Greek-English Lexicon, new ed. by H. S. Jones and R. McKenzie, Oxford, 2 vols., 1925–40.
MASB. Memoirs of the Asiatic Society of Bengal, 4°, Calcutta, 1905 f.
Med. Art. Princ. Medicae Artis Principes post Hippocratum et Galenum. Graeci latinate donati. [edited by Henricus Stephanus.] 2 vols., f° [Geneva], H. Stephanus, 1567. The authors are: Aretaeus, Rufus, Alexander Trallianus, Paul of Aegina, Cassius, Oribasius, Sextus Placitus, Celsus, Scribonius, Marcellus, Vindician, Serenus, Rhemnius, Auctarius, Nicolaus, Myrepsius, Demetrius Pepagomenus, Aetius Philaretus, and Theophilus. Two of the treatises of Oribasius illustrated with woodcuts. Signatures in 6's: in my copy **4; a–mm6; AAA–ddd 6; AAa–TTt 6; AAAa–FFFf6; AAAAa–ZZZZz6: AAAAaa–OOOOoo5; α–i (Greek letters).
Mém. Acad. Inscr. Mémoires de Littérature tirés des Registres de l'Académie des Inscriptions et Belles Lettres, Paris.
Mém. Acad. Roy. Belg., lett. cl. Mémoires de l'Academie Royale des sciences et belles-lettres de Belgique, classe des lettres . . . , Brussels.
Mém. Acad. Sci. Mémoires de l'Académie des Sciences de l'Institut de France.
Mém. div. Sav. Acad. Inscr. Mémoires présentés par divers Savants. Académie des Inscriptions et belles-lettres, 1844 f.
Mém. Soc. Roy. Géogr. d'Égypte. Mémoires de la Société Royale de Géographie d'Égypte (Société khédivale de géographie du Caire).
MGM. Mitteilungen zur Geschichte der Medizin und der Naturwissenschaften, Hamburg and Leipzig, 1902–42, 40 vols. (Wellcome Library).
MIE. Mémoires de l'Institut d'Égypte.
MVG. Mitteilungen der vorasiatisch–aegyptischen Gesellschaft.
N. Jahrb. klass. Alt. Neue Jahrbücher für das klassische Altertum, Leipzig.
NBG. Nouvelle Biographie Générale, ed. F. Hoefer, 46 vols., 1852–66 (vols. i–ix with title Nouvelle Biographie Universelle, NBU).
NBU — *see* NBG.
NEM. Notices et Extraits des Manuscrits de la Bibliothèque Nationale et autres Bibliothèques.
OCD. The Oxford Classical Dictionary, Oxford, 1949 (many refs. incorrect).

OR — *see* Berthelot (1).

Phil. Trans. Philosophical Transactions of the Royal Society.

Philol. Untersuch. Philologische Untersuchungen, ed. Kiessling and Wilamowitz-Moellendorf, 1880 f.

Philologus Suppl. Philologus. Zeitschrift für das klassische Alterthum, Supplement-Band, Göttingen.

Philosoph. Monatsh. Philosophische Monatshefte, Leipzig.

PG. Patrologia Cursus Completus. Patrologia Graeca, ed. J. P. Migne, Paris, tomus 1–161 in 165 vols., 1857–86 (Index by T. Hopfner, in parts., 1928–39).

PGM. Papyri Græcæ Magicæ. Die Griechische Zauberpapyri herausgegeben und übersetzt, ed. tr. K. Preisendanz, Leipzig, 2 vols., 1928–31 (BM copy full of MS. corrections; vol. iii Index, destroyed in MS. by an air raid in World War II).

PL. Patrologia Cursus Completus. Patrologia Latina, ed. J. P. Migne, Paris, tomus 1–221, 1844–64 (indexes in vols. 218–21).

Preisendanz — *see* PGM.

Proc. Brit. Acad. Proceeding of the British Academy 1903 f.

Proc. Roy. Soc. Med. Proceedings of the Royal Society of Medicine, 1907 f.

PW. Pauly, A. F. and Wissowa, G. Real-Encyclopädie des klassischen Altertumswissenschaft, Stuttgart, 1894 f.; II Reihe; Suppl.

QS. Quellen und Studien zur Geschichte der Naturwissenschaften und der Medizin.

RAC. Reallexikon für Antike und Christentum, ed. T. Klauser, Stuttgart, 1950 f.

Rec. Trav. Univ. Gand. Recueil de Travaux, Faculté de philosophie et lettres, Université de Gand, 1888 f.

Rev. Archéol. Revue Archéologique.

Rev. Bibl. Revue Biblique.

Rev. de l'Hist. des Religions — see Rev. Hist. Rel.

Rev. Étud. Grec. Revue des Études Grecs.

Rev. Hist. Rel. Revue de l'Histoire des Religions, Musée Guimet (Paris).

Rev. Philol. Revue de Philologie.

Rev. Scient. Revue Scientifique.

Rhein. Mus. Rheinisches Museum fur Philologie, Frankfurt a/M.

RN. Lucretius. De Rerum Natura.

Ro. ROSCHER, W. H. Ausführliches Lexikon der Griechischen und römischen Mythologie, Leipzig, 1909 f.

RPTK. Real. Encyklopädie für protestantische Theologie und Kirche, ed. J. J. Herzog and A. Hauck, 24 vols., Leipzig, 1896–1913.

RVV. Religionsgeschichtliche Versuche und Vorarbeiten, Geissen.

SBE. Sacred Books of the East, sev. vols., Oxford, 1852–66.

Sitzb. Akad. Berlin, (*phil.-hist. Kl.*). Sitzungsberichte der (Deutschen) Akademie der Wissenschaften zu Berlin, (philosophisch-historische Klasse).

Sitzb. Bayer. Akad. Sitzungsberichte der Bayerischen Akademie der Wissenschaften, Munich.

Sitzb. Erl. Sitzungsberichte der Physikalisch-medizinischen Societät in Erlangen.

Sitzb. Heidelberg Akad., Phil.-hist. Kl. Sitzungsberichte der Heidelberger Akademie der Wissenschaften, Philosophisch-historische Klasse, Heidelberg, 1910 f.

Στοιχεῖα, Leipzig.

Stud. Bibl. Warburg. Studien der Bibliothek Warburg, Leipzig and Berlin, 1922 f.

TM — *see* p. 53, note 9.

Trans. Inst. Chem. Eng. Transactions of the Institution of Chemical Engineers.

TU. Texte und Untersuchungen zur Geschichte der altchristlichen Litteratur, ed. Gebhardt and Harnack, Leipzig.

Verhl. Naturforsch. Ges. Basel. Verhandlungen der Naturforschenden Gesellschaft in Basel, 1854 f.

Vortr. Bibl. Warburg. Vorträge der Bibliothek Warburg.

VS — *see* Diels (1).

Z. Angew. Chem. Zeitschrift für angewandte Chemie.

Z. f. Ethnol. Zeitschrift für Ethnologie, 1869 f.

Z. f. Naturwissenschaft. Zeitschrift für die gesamte Naturwissenschaft, Braunschweig, Berlin, 1935–44.

Z. f. vergleich. Sprachenf. Zeitschrift für vergleichende Sprachforschung auf dem Gebeite des deutschen, griechischen und lateinischen, 1852 f.

Z. Indol. Iran. Zeitschrift für Indologie und Iranistik, Leipzig, 1922–36.

Z. neutest. Wiss. Zeitschrift für die neutestamentliche Wissenschaft und die Kunde des Urchristentum, Giessen.

Z. Phys. Chem. Zeitschrift für Physikalische Chemie, Leipzig.

Z. Wiss. Theol. Zeitschrift. für Wissenschaftliche Theologie, Jena.

ZDMG. Zeitschrift der Deutschen morgenländischen Gesellschaft.

PART I

THE THEORETICAL BACKGROUND

CHAPTER I

EARLY GREEK PHILOSOPHY

Ancient Cosmogonies

For the ancient nations, as with all primitive peoples, the explanation of natural phenomena was a branch of theology, and the phenomena were regarded as manifestations of the intervention of gods. In an Egyptian account, an ocean of primordial water, Nu, circumscribing the world and symbolised by a serpent with its tail in its mouth, contained male and female principles and generated an egg, from which issued the sun god in the form of a scarab beetle. The sun god created other gods and beings as emanations by his voice.[1] The idea of the cosmic egg, filled with life-force, is very old and widespread, appearing perhaps independently in Egyptian, Persian, Syrian, Phoenician, Hebrew, Indian, Chinese, and Greek, but apparently not in Babylonian texts.[2] The Babylonians regarded water as the first uncreated principle.[3]

Sanchuniathon, a Phoenician of Sidon (*c.* 1200 B.C.), whose book was translated into Greek by Philo of Byblos (A.D. 64–161), says the cosmic egg, Mōt, was produced by an epicene (male-female) being Pothos, which arose from chaos and a wind of dark air (πνευματώδη).[4] Sanchuniathon is said by Poseidonios (135–51 B.C.) to have 'originated the ancient opinion about atoms'.[5] Sanchuniathon is said[6] to have taken air and ether as first principles, which generated two divine beings who produced an egg, which broke to form the earth and the sky. Some ancient[7] and modern[8] authors claimed that

[1] Budge, (1), i, 96 f., 107f., 282 f., 294 f., 357 f., 461; Farbridge, 1923, 20, 74; G. Rawlinson, *History of Phoenicia*, 1889, 226; Reitzenstein, (2), 60 f.; Roeder, Ro., iv, 1173, 1191, 1201; *id.*, *A. Rel.*, xv, 86.

[2] Arrhenius, *The Life of the Universe*, 1909, i, 17; Cumont, PW, iv, 2236; Dasgupta, (1), i, 25; Eisler, (1), 53, 188, 398 f., 448, 508, 524; *id.*, (2), 5; Eliade, (3), 410 (bibl.); Farnell, 180; Gomperz, (2), i, 546; Gressmann, *A. Rel.*, 1922, xx, 1 (34); Lippmann, (4), 1 f.; E. Meyer, (2), ii, 103; Needham, (1), ii, 78; Nilsson, *A. Rel.*, xi, 530, 544; Seeliger, Ro., vi, 430 f.; H. J. Sheppard, *Ambix*, 1958, vi, 140; W. Scott, (1), ii, 115.

[3] Eliade, (3), 188; Langdon, *Isis*, 1922, iv, 423; Ungnad, *ib.*, 1925, vii, 256.

[4] Eusebios, *Pr. Evang.*, bk. i, chs. 9–10; (1), i, 33 f.; revised text in W. Scott, (1), ii, 113–17 C. Clemen, Die phönikische Religion nach Philo von Byblos, MVG, 1939, xlii, no. 3 (text, tr., essays, bibl.); Bousset, (1), 105; G. Conteneau, *La Civilisation Phénicienne*, 1926, 100; A. B. Cook, ii, 1036; Cory, (1), 3 f.; (2), 1 f.; Deubner, Ro., iii, 209; Laqueur, PW, xv, 2314; Müller, FHG, iii, 560; Paton, ERE, xi, 177.

[5] Strabo, XVI, ii, 24 756C.

[6] Damaskios, i, 125, in (2), ii, 358; A. B. Cook, ii, 1036 f.; Cory, (1), 319; E. Meyer, (1), II, ii, 179; Paton, ERE, ix, 889; see p. 235.

[7] Athenaios, iii, 100; Josephus, *Antiq.*, i, 3, 9; Tatian, *Oratio ad Graec.*, 37, ANL, iii, 41; Fabricius, (1), (*b*), i, 226.

[8] P. Collinder, q. in *Isis*, 1940 (1947), xxxii, 448; Cudworth, i, 31; Dickenson, *Physica Vetus et Vera*, 1702, 11; Jablonski, i, 12; Newton, *Opticks*, Query 28, 1730, p. 343; Ritter, *Geschichte der Philosophie*, 2 ed., 1836, i, 165.

Demokritos (even Leukippos) visited Sidon, but there is no evidence that he did, or had any knowledge of Mōchos.[1]

Orphicism

In the 6 cent. B.C. a set of ideas attributed to a Thracian, Orpheus, were in circulation in Greece. These are mostly known through late authors, but some Orphic fragments engraved on gold sheets were discovered, and the modern tendency is to accept the ancient origin of the beliefs. The main teaching is that the soul is of celestial origin, a fallen god. The body (σῶμα) is the tomb (σῆμα) of the soul, which reveals its true nature when out of the body, in a state of ecstasy (ἔκστασις, 'stepping out'). The soul could be restored to its former stage by ascetic life, sacraments and purifications, which released it from the 'wheel of birth', which restrained the original soul to a succession of reincarnations in human, animal, and even vegetable, forms. The underlying idea is Indian and may have reached Greece through Persia. The technical term used by the Pythagoreans (see p. 11) was 'rebirth' (παλιγγενεσια), not 'transmigration' (μετεμψύχωσις). Herodotos (ii, 123) thought the idea was Egyptian, but[2] this is incorrect. The fragments attributed to Orpheus, in verse,[3] are of little interest to us; in their present form they are probably of the 1 to 3 cents. A.D.[4]

The Orphic cosmogonies (and those in Hesiod) are extravagant and repulsive. Time (χρόνος, *Chronos*) and Kronos (κρόνος, *Kronos*, the Roman Saturn) were identified. An androgyne (male-female) winged god Phanes (or Erikepaios) produced a silver (ἀργύρεον) or silvery-white (ἀργύφεον) egg, and globular male-female beings are split by a god into male and female parts, a myth known to Plato.[5] The later gnostic sects (Simon Magus, the Naassenes Peratae, etc.) had a male-female force (ἀρσενόθηλυς δύναμις).[6] Ψ-Clement[7], gives the Orphic doctrine that chaos produced an egg, which developed all colours and forms, as the peacock's egg of one colour has in it potentially all the colours of the bird. By the indwelling divine spirit (πνεῦμα θεῖον, a male-female (ἀρρενόθηλυ) being called Phanes appeared, which rose to heaven,

[1] Zeller, (1), I, i[7], 28; I, ii[6], 1048; III, ii[3], 244.

[2] Hopfner, (1), 197.

[3] E. Abel, *Orphica*, Leipzig, 1885; O. Kern, *Orphicorum Fragmenta*, 1922; Diels, (1), i, 1; Freeman, (2), 1; the lapidary (*Λιθικά*) is spurious.

[4] Festugière, (1), i, 345 f. (belong to the same circles as the *Hermetic Books* and show Neoplatonic influence); for Orphicism in general see: Anrich, 22; Bapp, Ro., v, 994 (Titans, Kronos); A. Boulanger, *Orphée. Rapports de l'Orphisme et du Christianisme*, 1925; Burnet, (1), 7, 81; (2), 43; A. B. Cook, ii, 1019–54; Damaskios, (2), i, 181; ii, 122; Deubner, Ro., iii, 2091 (Orpheus); Deussen, (1), II, i, 25; Diels, *A. Rel.*, 1923, xxii, 1; Dieterich, (1), 126; Eisler, (1), (2), (3); Eitrem, PW, vii, 471; Fimmen, *A. Rel.*, 1920, xvii, 515; Freeman, (1), 1949, 1; Gomperz, (2), 1901, i, 41, 84, 90, 127, 526; Gruppe, Ro., iii, 2245 (Phanes); W. K. C. Guthrie, (1), 1935, 1952 (best account); Hommel, *A. Rel.*, 1925, xxiii, 195; W. Jaeger, (2); O. Kern, *Orpheus, eine religionsgeschichtliche Untersuchung*, 1920; Leisegang, PW, II Reihe, iii, 1037; Lobeck, i, 233; ii, 787–1104; Mayer, Ro., v, 1008 (Kronos); E. Meyer, (1), 1893, ii, 734; 1937, iii, 679; L. Moulinier, *Orphée et l'Orphisme à l'Époque Classique*, 1955; Pohlenz, PW, xi, 1988 Preisendanz, PW, xix, 1761 (Phanes); Seeliger, Ro., vi, 430–505 (434 Orphics, 478 Kronos, 486 Phanes); Waeser, PW, iii, 2482; vi, 486; Wernicke, PW, i, 1093; Zeller, (1), 1923, I, i, 96–148; Ziegler, Ro., v, 1519, 1534.

[5] *Banquet*, 189*a*; Eisler, (1), 96, 426 f. (the androgyne Iranian god Zurvān); Guthrie, 1952, (1), 80 f., 85, 92 f., 144.

[6] Hippolytos, v, 7, 14; vi, 18; (1), 138, 184, 252; Leisegang, PW, II Reihe, iii, 1037.

[7] *Homil.*, vi, 5–6, 12.

while the rest of the matter sank in the depth as Pluto (so-called from its great quantity, πολὺ), the king of the dead (νεκρῶν βασιλέα). The Orphic egg of Phanes, the Egyptian egg of chaos,[1] and the Syrian egg of Aphrodite[2] which fell into the Euphrates and was pushed out by a fish, were united by the gnostic Peratae (see p. 258) and Basileides into the 'egg in the waters' or the 'matrix of all' (ἓν τὸ πᾶν), containing potentially 365 beings.[3]

The idea of the 'golden chain (σειρή χρυσείη) of Homer' is perhaps Orphic[4] although it first occurs in a commentary by Proklos (5 cent. A.D.) on Plato's *Timaios*.[5]

Reputed followers of Orpheus were Epimenides of Crete (6–5 cents. B.C.) and Mousaios of Athens (pre-Homeric), who taught that 'everything comes out of one and is resolved into one'.[6] Aristotle[7] says the 'so-called Orphic poems' taught that 'the soul enters from the universe into animals when they breathe, borne by the winds (φερομένην ὑπὸ τῶν ἀνέμων)'.

Early Greek Philosophy

It is probably true to say that the Greeks were the first to treat nature and man as problems which could be solved by reason. The new interest began in the Ionian colony in Asia Minor, which had been under strong Egyptian and Babylonian influence from about 750 B.C., but more markedly from about 450 B.C. Later developments occurred in Magna Græcia (S. Italy). Greece proper was not so important until Plato's time. Miletos was for a time under the control of Lydia, then under strong Asiatic influence; the Persian empire under Cyrus and Darius included Media, Persia, Lydia, Babylonia, Egypt, the Asiatic Greeks, and the whole of western Asia, and was in touch with India before Alexander's conquests. There was a Greek settlement at Naukratis in the Egyptian Delta in the 7 cent. B.C., and the Phoenicians were well known to the Greeks. The indebtedness of Greek philosophy to the East was later exaggerated by some Greek authors but recent scholarship admits some, and in some cases important, influence.[8]

[1] Lepsius, (2), 204 f.

[2] Nigidius Figulus, ed. Swoboda, Vienna, 1889, 126; A. B. Cook, i, 584; Cumont, PW, iv, 2241.

[3] Schultz, lxx, 113 f., 148.

[4] Eisler, (1), 419.

[5] H. Kopp, (4), ii, 30 f., 88, 208, 250 f., 277; *id.*, *Aurea Catena Homeri*, Brunswick, 1880 (pp. 52), 27 f., 38 f.; T. Taylor, (1), i, 264.

[6] Freeman, (1), 1949, 19–44; (2), 1948, 7–18; VS, i, 20–60; incl. Pherekydes of Syros (7 or middle of 6 cent. B.C.) and Akousilaos of Argos (6 cent. B.C.).

[7] *De Anima*, i, 5, 410*b*.

[8] C. Bailey, (1), 110 f.; Bousset, (2), 256; Burnet, (1), 2 f., 15 f., 25 f., 44, 88; Bury, CAH, iv, 520; Chwolsohn, (1), i, 751 f.; ii, 238, 298, 336, 703; Cornford, CAH, iv, 538; *id.*, (1); Eisler, (3), 84; Festugière, (1), i, 19–44; *id.*, *Revue Hist. Rel.*, 1945, cxxx, 29–41; Filliozat, (1), 199 f.; Fotheringham, *Isis*, 1923, vi, 204; E. Frank, 78 f.; Fuchs, in Puschmann, (1), i, 153; Gruppe, Ro., iii, 1146, 2263; Hogarth, CAH, ii, 542; Hopfner, *Beih. a. O.*, 1925, iv, 9, 11, 15 f., 49, 67, 82; *id.*, PW, xiv, 306; Karpinski, *Isis*, 1922, iv, 348; D. Mallet, 125 f., 139 f.; Martini, PW, v, 540, 561; Marvin, *Nature*, 1930, cxxvi, 394; E. Meyer, (1), II, ii, 41; G. Murray, (1), 59 f., 81; Nilsson, *A. Rel.*, xiv, 423; Otto, (1), 17 f.; Puech, in *Mélanges Bidez*, Brussels, 1934, ii, 745; Ramsay, *Asianic Elements in Greek Civilisation* (Gifford Lectures, 1915–16), 1927, 4, 9; Riess, PW, ii, 1802; Rostovtzeff, (1), i, 193, 240, 250; Schubart, (1), 5 f.; J. S. C. Schweigger, *Über die älteste Physik und den Ursprung des Heidenthums aus einer missverstandenen Naturweisheit,*

The appreciation of the problems to be solved and the ideas of matter, change, elements, and atoms, mostly despised by Plato, are the abiding positive contributions of Greek philosophy to science.

The early Ionian philosophers were concerned with the meaning of 'change' or 'coming into being and passing away' (γένεσις καὶ φθορά; *generatio et corruptio*) regarded as a self-evident fact. Existence continues in the midst of change because the latter is only apparent, and there is a permanent underlying substrate (ὑποκείμενον) or principle, later (by Anaximandros,[1] or Aristotle[2]) called origin (ἀρχή), essence (οὐσια), or 'the one' (ενός), from which all things are formed and into which they ultimately return. Burnet[3] thought this was first called φύσις (*physis*), a name perhaps derived from φύω (*phyo*), I grow,[4] the whole cosmos being like a growing plant (φύτον, *phyton*) or animal. There is no good evidence that the word φύσις was used in a technical sense by the Ionian philosophers.[5]

Change is due to a special type of rearrangement (μεταβολή, *metabolé*) of the primary matter (οὐσία, *ousia*), a kind of 'allotropic' change (αλλοίωσις, *alloïōsis*), produced by condensation (σύγκρισις, *synkrisis*) or rarefaction (διάκρισις, *diakrisis*) by the known effects of heat and cold. The origin of this theory, whether meteorological or physiological, is obscure, and its relation to Egyptian, Babylonian, and Iranian ideas uncertain.[6]

THALES

The three earliest philosophers, Thales, Anaximandros, and Anaximenes, were all born in Miletos, the most southern Ionian city in Asia Minor, in the 6 cent. B.C. Thales (fl. 585 B.C.), perhaps of Phoenician ancestry[7], taught, according to Aristotle,[8] that: (i) the primary substance is water (ὕδωρ), (ii) the earth floats on water, (iii) all things are full of gods, (iv) the magnet is alive for it attracts iron. Diogenes Laertios,[9] on the authority of Hippias (fl. 420 B.C.), adds amber (which when rubbed attracts straws) to the magnet. There are no genuine fragments of Thales.[10] Pindar (518–438 B.C.) said[11] 'the best is water' (ἄριστον μὲν ὕδωρ).

Hippolytos[12] says Thales taught that the principle of the universe was from first to last water (ἀρχὴν τοῦ παντὸς εἶναι καὶ τέλος τὸ ὕδωρ).

Nürnberg, 1821 (32 pp.); Scoon, 248; J. A. Stewart, (1), 473, etc.; Ure, CAH, iv, 107; Wilamowitz-Moellendorf, (1), ii, 207; Windelband, (1), 25; Woolley, *The Sumerians*, Oxford, 1928, 193; Zeller, (1), I, i[7], 246, 266. Cornford's, CAH, iv, 538–78, representation of Greek philosophy as a continuous organic development from its beginnings is questionable.

1 Deussen, (1), II, i, 42. 2 Burnet, (1), 11. 3 (1), 10, 54, 363.

4 Murray, (1), 126; Lippmann, (4), 19; Leisegang, PW, xiii, 1050; A. Mansion, 59 f., 84 f.

5 Scoon, 32, 299; Leisegang, PW, xx, 1129–63; Windelband, (1), 73.

6 Burnet, (1), 1920, 10, 49, 53, 73, 363; Gilbert, (1), 15, 28, 38, 47, 51, 85, 97, 254; *id.*, *A. Rel.*, xiii, 306; Langdon, *Isis*, 1922, iv, 423; Fotheringham, *ib.*, 1923, vi, 204; Ganszyniec, *A. Nat.*, 1922, ix, 1; Preisigke, *A. Rel.*, 1926, xxiv, 112; Hopfner, PW, xiv, 301; E. Meyer, (1), 1915, iv, 198.

7 Hogarth, CAH, ii, 557. 8 *Metaphys.*, i, 3; *De anima*, i, 5; *De cœlo*, ii, 13.

9 i, 22–4: ἐκ τῆς λίθου τῆς μαγνήτιδος καὶ τοῦ ἠλέκτρου: the first mention of magnetism and electricity in relation.

10 Baeumker, 8; Burnet, (1), 40; Freeman, (1), 1949, 49; (2), 19; Goebel, 9; Ueberweg, (1), i, 42; VS, i, 67; Zeller, (1), I, i[7], 253.

11 *Olymp.*, i, 1. 12 *Refutat.*, i. 1.

It is not known why Thales selected water; Aristotle says it was because the nutriment of all things is moist and heat is generated from the moist and kept alive by it; the seeds of all things have a moist nature and water is the origin of moist things. Thales may have known the Egyptian belief that life germinated from water, or in Greek mythology that Ocean and Tethys were the first parents of things; or he may have started with meteorological phenomena (as Gilbert suggested), the transformation of solid ice into liquid water and liquid water into vapour or mist (identified by later Greek philosophers with air). He may have spoken of processes like condensation or mixing, but no record of his explanation of how things arose from water survives.

Aristotle says Thales chose water to support the earth because wood floats on water but not on air. Plato says 'all things are full of gods' but does not name Thales. Thales was credited with the idea that the soul in its essence is always in motion and self-moving. The belief that a life or soul is inherent in matter was called 'hylozoïsm' by Cudworth (1678) and persisted in Greek philosophy. The magnet was the stock example of the existence of occult forces in the Middle Ages.[1]

ANAXIMANDROS

Anaximandros ('Anaximander'), b. 610 B.C., is described as a follower of Thales[2] and published *c.* 546 B.C. a prose work which survives only in fragments.[3] Diogenes Laertios[4] says he 'chose as principle (ἀρχή) or element (στοιχεῖος, this name is later) something which is unlimited (ἄπειρον, *apeiron*), without defining it as air or water or anything else, the whole being unchangeable although the parts could change'.

Theophrastos, who had his book *On Nature* (περὶ φύσεος), says Anaximandros took as a primary substance an undefined being (ἀόριστος φύσις) or an unlimited (ἄπειρον) and eternal substance, a reservoir from which the waste of existence could be repaired and into which existence could return. It was something apart from the strife of the opposites heat and cold, from which, as from a homogeneous (not mechanical) mixture (μῖγμα), individual things can be separated by a kind of winnowing or sifting (ἀπόκρισις), an eddy, or vortex motion which is inherent in it. The mixture is 'a complete fusion'.[5] Philoponos said the *apeiron*, which is material, is a mean between air and water in the scale: fire-air-water-earth.[6] Things pass away again into the *apeiron* 'as is meet, for they make reparation and satisfaction to one another for their injustice according to the ordering of time'. The *apeiron* is divine, immortal, and surrounding and governing the innumerable worlds.

Anaximandros first postulated four pairs of opposites for the four elements. The difficulty of Thales' water as a substrate which constantly changed was avoided; *apeiron* was unlimited, eternal, and indestructible. The process of 'separating out' by an 'everlasting motion' gave an explanation for change (not

[1] Burnet, (1), 1920, 49; Deussen, (1), II, i, 39, 112; Ganszyniec, *A. Nat.*, 1922, ix, 1; Gompez (2), 1901, i, 245; Zeller, (1), I, i^{7}, 264.

[2] Frank, 46, thought Thales is mythical and Anaximandros the first Greek philosopher.

[3] Baeumker, 11; Burnet, (1), 50; Deussen, (1), II, i, 41; Diels, *N. Jahrb. klass. Alt.*, 1923, li, 65; Freeman, (2); Ganszyniec, *A. Nat.*, 1922, ix, 1; Goebel, 14; Gomperz, (2), i, 533; J. Neuhaeuser, *Anaximander Milesius*, Bonn, 1883; Robin, 39; P. Seligman, *The Apeiron of Anaximander. A Study in the Origin and Functions of Metaphysical Ideas*, 1962 (elements, 35 f., φύσις, 50 f.); Ueberweg, (1), i, 46; VS, i, 81; Zeller, (1), I, i^{7}, 270.

[4] ii, 1.

[5] Ross, (2), ii, 352.

[6] Goebel, 20.

provided by Thales), although Anaximandros gave no exact meaning to it; it may have meant only the breaking off of a finite portion of the non-limited. The return of the opposites to the non-limited he seems to have regarded as a means of adjusting their mutual strife and encroachment. The opposites hot-cold were original, the other pair, moist-dry, being derived from this.

Anaximandros had an elaborate cosmogony and some interesting biological ideas; living beings arose from the moist element as it was evaporated by the sun.[1]

Anaximenes

Anaximenes of Miletos (fl. 546 B.C.) took over Anaximandros' idea of the non-limited in quantity but restored to it a definite quality, calling it air (ἀήρ) or breath (πνεῦμα). Burnet thought ἀήρ meant 'vapour' but Zeller and most modern authors take it to mean 'air'.[2] Anaximenes did not suspect the existence of gaseous atmospheric air but regarded 'air' as invisible in its 'equable (ὁμαλώτατος)' form, becoming visible only when it forms fire, water, or earth. He gave detailed explanations of meteorological phenomena. He replaced Anaximandros' vague 'separating off' by well-defined condensation (πυκνότης, πύκνωσις) or 'felting (πίλησις)', and rarefaction (μανότης, μάνωσις, ἀραίωσις, διάκρισις), i.e. a quantitative difference of density of only one principle. Air on rarefaction becomes fire, on condensation cloud, water, earth, and stones, with increasing density. This 'ladder of being' is limited at each end:

fire ← air → wind → cloud → water → earth → stone,

and is also a scale of mobility. Air is in constant motion, giving rise to change in an unspecified way. Rarefaction is connected with increase of temperature (warm breath from the mouth) and condensation with decrease of temperature (cold air blown from the contracted lips: Aristotle correctly said that 'the air in front of the mouth is propelled, and this is cold'.) The sun is hot because of the swiftness of its motion. Air is also breath (πνεῦμα), which is the same as life and soul (ψυχή), and 'holds bodies' together; the boundless mass of air outside the cosmos holds this together also.[3] Anaximenes regarded the heavenly bodies, which were flat and like leaves floating in air, as pieces of the earth rarefied by fire.

Herakleitos

Herakleitos of Ephesos (fl. *c.* 500 B.C.) postulated one fundamental substrate, fire, perhaps (since he mentions the Magians) under Persian or Indian

[1] Zeller, (1) I, i[7], 304; this theory is given by Diodoros Siculus, i, 7, 10, as Egyptian, and it may have been suggested by the production of life from the Nile mud.

[2] Baeumker, 15; Burnet, (1), 1920, 72, 352; Freeman, (1), 1949, 64; Gilbert, 1907, 94; Goebel, 33; Tannery, (1), 1925, vii, 187, 309; Ueberweg, (1), i, 50; VS, i, 90; Zeller, I, i[7], 315 (322 meaning of ἀήρ).

[3] A fragment of Anaximenes in an alchemical work of Olympiodoros, Berthelot, (2), ii, 83, 7; also quoting Anaximandros, was regarded by Gomperz, *Hermes*, 1932, lxvii, 155 (159), as genuine, but since it uses the word ἀσώματος, Diels considered it to be spurious.

influence.[1] Herakleitos wrote one book which he deposited in the temple of Artemis at Ephesos. His style is brief and full of metaphors, so that he was called 'the Obscure'.[2]

A steadily-burning flame remains apparently the same, yet its substance is constantly changing. He says:

> This ordered universe (κοσμος), which is the same for all, was not created by any one of the gods or of mankind, but it was ever and is and shall be ever-living Fire, kindled in measure and quenched in measure.
>
> To souls, it is death to become water; to water, it is death to become earth. From earth comes water, and from water, soul.
>
> Sea water is the purest and most polluted; for fish, it is drinkable and life-giving; for men, not drinkable and destructive.

The statement that 'everything flows (πάντα ῥεῖ)' attributed to Herakleitos by Plato[3] is perhaps not a literal quotation. He says: 'All things are one (ἓν τὸ πάν, one the all), one is from all and all is from one (ἐκ πάντων ἓν καὶ ἐξ ἑνὸς πάντα). There is an exchange; all things for Fire and Fire for all things, like goods for gold and gold for goods.' Fire becomes moist, and moisture becomes earth by a 'downward path' (ὁδὸς κάτω, *hodos kato*); the reverse changes constitute an 'upward path' (ὁδὸς ἄνω, *hodos ano*). This introduces the idea of 'finer' (fire, air) and 'coarser' (water, earth) elements.

It is uncertain whether Herakleitos used the idea of condensation and rarefaction (named by Aristotle); he perhaps thought of a *qualitative* change;[4] he uses the word 'exchange' or 'anhalation' or 'exhalation' (ἀναθυμίασις), a 'rising (ἄρσις)' of vapour or smoke (a term used in later chemical texts for distillation) for the upward path when particular substances return to fire. He has no corresponding technical term for the downward path when things are created from fire, and seems to have been more interested in destructions and return to fire. His expression ὁδὸν ἄνω καὶ κάτω is a technical one. The exact meaning of Fire is not clear; Burnet said 'ordinary fire'; Brieger, fire matter ('Wärmestoff'); Windelband 'a process rather than a substance'; Reinhardt an expression of the 'world-reason (ἓν τὸ σοφόχ)' manifested in material fire (which seems to be rather a Stoic idea); Nestle a dry exhalation later called 'breath (ψυχή)'.[5] It seems to have had a vague meaning of the modern 'energy'.[6]

'Fire lives the death of air and air lives the death of fire; water lives the death of earth, earth that of water.' Perhaps 'air (ἀέρος)' is a later addition,

[1] Burnet, (1), 1920, 141; Gilbert, *A. Rel.*, xiii, 320; K. Joël, 314; E. Meyer, (1), iii, 120; iv², 225; Windelband, 1893, 36; Zeller, (1), 1920, I, ii⁶, 935.

[2] *Heracliti Ephesii reliquiae rec.* I. Bywate, Oxford, 1877; Diels, *Herakleitos von Ephesos, griechisch und deutsch*, 1901, 1909; *id.*, VS, i, 139, 150; Freeman, (1), 1949, 104, 128; (2), 1948, 24. Adam, 214; Baeumker, 19; F. J. B. Brecht, *Heraklit*, Heidelberg, 1936; Burnet, (1), 133; Deussen, (1), II, i, 103; J. Drummond, i, 29, 42; A. M. Frenkian, *Études de Philosophie Présocratique. Héraclite d'Éphèse*, Cernauti, 1933; O. Gigon, *Untersuchungen zu Heraklit*, Leipzig, 1935; Gilbert, 94; Guthrie, (1), 1952, 224; Heinze, 3; K. Joël, 277–324; F. Lasalle, *Die Philosophie Herakleit des Dunkel von Ephesos*, 2 vols., 1858; E. Pfleiderer, *Die Philosophie Herakleit von Ephesus im Lichte der Mysterienidee*, 1886; Robin, 71; Ueberweg, (1), i, 53; P. Wheelwright, *Heracleitus*, Princeton, 1959 (bibl.); Zeller, (1), I, ii⁶, 783–939.

[3] *Kratylos*, 440*c*: πάντα ὥσπερ κεράμια ῥεῖ; cf. *ib.* 411*c*, 412*d*, 439*e* f.; Aristotle, *De Coelo*, i, 10, 279*b*, says he taught that nothing steadfastly is.

[4] Burnet, (1), 147; Zeller, (1), I, ii⁶, 819.

[5] Zeller, I, ii⁶, 811, 815.

[6] K. Joël, 279.

since Herakleitos seems to admit only three elements, fire (πῦρ), water (θάλασσα, 'sea'), and earth (γῆ).[1] 'Cold things grow hot, hot things grow cold, the wet dries, the parched is moistened.' The direct change of fire to water (without the intermediary of air) is unexpected; Herakleitos may have been thinking of the quenching of fire by water, also that water is half vapour and half earth: 'The changes of fire are, first to sea; but of this sea, half is earth and half fiery cloud.' The downward path is sea, earth (air is omitted); the fiery cloud and exhalations are the effect of fire on water on the upward path. (Empedokles first definitely separated air from fire.) The sun is the size we see it and is not only new every day but continuously new; it is an intelligent kindling, made (of vapour) from the sea.

The existing arrangement of things is maintained by the strife (πόλεμος) or tension of the opposites; there is an interlocking of opposites at a particular stage in their contest, and the particular thing so created continues to exist as long as this tension is maintained, like the tension of a bow or a lyre, and hence there is an 'attunement' (ἁρμονία, *harmonia*, not 'harmony'). Herakleitos seems to have assumed that the whole is pulled gradually in the direction of fire, to which all will ultimately return,[2] but the periodical destruction of the world by fire (εκπύρωσις, *ekpyrosis*) is a later (Stoic) theory.[3]

Herakleitos referred to the four colours, white, black, yellow, and red, which reappear in Empedokles (p. 17) and Demokritos (p. 38): 'Nature strives towards opposites and brings attunement from them and not from likes . . . as the painter mixes the white, black, yellow, and red colours and achieves likeness to the original.'[4]

There is no 'essence' or anything to know in any particular object. There is something above the process and substrate which unites them which is not material, the *logos* (λόγος). There has been much discussion on the meaning of *logos* in Herakleitos. Burnet and Diels translated λόγος as 'word' or 'speech'; Zeller and Nestle 'reason (Vernunft)';[5] Ueberweg[6] 'world law (Weltgesetz)'; 'the rationality of the world process, the law of change, which comes to self-consciousness in the philosopher.'[7] It took a definite technical meaning with the Stoics, who drew on Herakleitos. The *logos* operates by 'measure' and makes the world intelligible, governs the upward and downward paths and the measure of their recurrent cycle, arranges the tension of the opposites, their balance, and their changes; governs the life of animals, and is in ourselves and by means of it we know, for wisdom is a property of fire. The senses are untrustworthy but sight is more accurate than hearing or smell (although 'if all things were turned to smoke the nostrils would distinguish them'). In breathing there is drawn in from the surrounding life or fire a vital heat which nourishes the portion of fire in the body.[8]

A Herakleitian school, in the sense of the Eleatics, Atomists, etc.,[9] is doubt-

[1] Burnet, (1), 135; Zeller, I, ii[6], 821.
[2] Freeman, (1), 1949, 113; Robin, 1928, 73.
[3] C. Bailey, (1), 22 (contradicts his idea of equilibrium); Burnet, (1), 158. Deussen, (1), II, i, 102, 416; Gilbert, 235; K. Joël, 322 (due to Herakleitos); Zeller, (1), I, ii[6], 866, 879.
[4] VS, i, 153.
[5] Zeller, (1), I, ii[6], 793, 840 f.
[6] (1), i, 58.
[7] Matthews, OCD, 512.
[8] Hoefer,(1), i, 79.
[9] Zeller, I, ii[6], 937.

ful; Plato[1] says the Herakleitians 'sprang up here and there on their own'. Ainesidemos (1 cent. B.C.) claimed to follow Herakleitos but took air (ἀήρ) as the primary substance, perhaps in the sense of *pneuma*, which Theophrastos (see p. 123) had identified with fire and the Stoics (see p. 149) called creative fire (πῦρ τεχνικὸν).[2]

Before continuing the theories of the 'elements' originated by the Ionian philosophers and Herakleitos, we must interrupt the narrative by the consideration of quite different schools, the Pythagorean and Eleatic.

The Pythagoreans

Pythagoras of Samos emigrated about 531 B.C. to Kroton, a Greek colony in S. Italy, where there was a medical school (see p. 27). He founded a community rather than a school. After 20 years he left for Metapontum, in S. Italy, where he died in 497 B.C. That his teacher was Pherekydes of Syros (fl. *c.* 550 B.C.) is doubtful, and his instruction by Zalmoxis the Thracian (really a god of the Getæ,[3] is an invention of Plato.[4] His travels to Egypt, Chaldæa, and Phoenicia are legendary, but he may have got some information about India by way of Persia. He left no writings and discouraged publication by his followers, who were organised in a 'brotherhood' which included women. He taught a 'way of life' (τρόπος τοῦ βίου), in which release from transmigration (παλιγγενεσία) was to be attained by asceticism, purification (κάθαρσις), ritual, and the study of philosophy (φιλοσοφία), a name he first used, and particularly of mathematics (μαθήματα), perhaps also a Pythagorean name. His principles were closely related to Orphicism (see p. 4) and Creuzer called the Pythagoreans 'reformed Orphics'. As a religious teacher and a mathematician, Pythagoras is mostly outside our interests, but some of his ideas must be considered. In later times his memory was surrounded by legends; the Neopythagoreans were an important development from our point of view (see p. 209). His introduction of mathematics into philosophy greatly impressed Plato.[5]

Zeller and Robin dealt with the early Pythagoreans (*c.* 500–350 B.C.) as fairly homogeneous; Burnet separated them into older and younger (beginning with Philolaos). Aristotle[6] gives the views of 'the so-called Pythagoreans' (οἱ

[1] *Theaitetos* 179E; Freeman, (1), 1949, 130.
[2] Zeller, (1), III, ii[4], 36 f.; πνεῦμα = ἀναθυμίασις = warm air = air + fire; αἰθήρ = air for Herakleitos.
[3] Herodotos, iv, 94–5. [4] *Charmides*, 156*d*.
[5] Baeumker, 33; Bousset, (1), 229; Burnet, (1), 84–112, 276 f.; *id.*, ERE, x, 520; A. E. Chaignet, *Pythagore et la Philosophie Pythagoricienne contenant les Fragments de Philolaüs et d'Archytas Traduits pour la première fois en français*, 2 vols., 1873 (BM 8485. df. 7); Philolaos, i, 226; Archytas, i, 255; Creuzer, (1), i, 254; ii, 189; A. Delatte, *Mém. Acad. Roy. Belg., lett. cl.*, 1922, 8°, xvii, no. 2 (pp. 270); Deussen, (1), II, i, 56; Eisler, (1), i, 539, 645 (Pherekydes); Elbern, *A. Rel.*, 1923, xxi, 445; Farrington, 1944, i, 36; Frank, 11, 67, 72 f., 79, 87 f., 260, 356; Freeman, (1), 1949, 36, 73, 245; (2); von Fritz, PW, xix, 1991; Furtwängler, iii, 262; Goebel, 133; Gomperz, (2), i, 127; Grote, (1), iv, 317, 323; Guthrie, (1), 1952, 216 f.; Heidel, *Amer. J. Philol.*, 1940, lxi, 1; Hoefer, NBG, 1862, xli, 238; *id.*, (4), 90; Hopfner, *Beih. a. O.*, 1925, iv, 14, 17; Karpinski, *Isis*, 1922, iv, 348; I. Lévy, Recherches sur la source de la légende de Pythagore, BEHE *Sci. Rel.*, 1926, xlii, 1–149; C. P. Mason, DBM, iii, 616; Robin, 50, 58, 117 f.; Ueberweg, (1), i, 56; Zeller, (1), I, i[7], 102, 361–617.
[6] *Metaphys.*, i, 5.

καλούμενοι Πυθαγόρειοι), or 'some of the Pythagoreans', rather than Pythagoras. Nestle[1] thought the development was gradual. Philolaos is said to have first published Pythagorean teachings, but others say this was done by Hippasos (who is said to have discovered the harmonic mean).[2] Xenophanes (*c.* 530 B.C.) knew that Pythagoras taught 'rebirth'.[3]

The Pythagoreans taught that 'things are numbers (*ἀριθμοί*)'.[4] Odd numbers are better, or more complete, than even, because they are limited in division, leaving a middle part when divided ($5 = 2 + 1 + 2$), and always giving an odd number when added to an even one. Macrobius (*c.* A.D. 400)[5] has a long section on the occult meaning of numbers, male (odd) and female (even) numbers, the harmony of the spheres and musical accords, 'as Pythagoras taught', and the doctrine in Plato's *Timaios* that the world soul consists of numbers. For the old Pythagoreans, ten, the *tetraktys* (*τετρακτύς*) was a 'powerful' number, since it is the sum of the first four numbers: $1+2+3+4=10$. Points arranged in four superimposed rows decreasing from 4 to 1 form a triangle representing the *tetraktys*. Zeller[6] denied any geometrical extension of Pythagoras's numbers, which were purely arithmetical and had no suggestion of atomism. Burnet[7] supposed that 'the Pythagorean points have magnitude, their lines breadth, and their surfaces thickness', and Cornford[8] interpreted the points as monads (*ὄγκοι*), forming linear, plane, and solid (1 point, 2 line, 3 triangle, 4 pyramid) numbers, a 'geometrical atomism'[9] before Leukippos and Demokritos, but this is doubtful. Diogenes Laertios[10] says the Pythagoreans started with the monad, the monad and dyad formed numbers, these formed points, lines, plane figures, and solid bodies; the last formed sensible bodies, of which there are four elements, fire, water, air and earth.

The Greeks did not regard unity as a number; their numbers began with 2.[11] Aristotle[12] says the Pythagoreans taught that 'things can arise from the One by repetition; in space the One can repeat to Two, and since this can go on for ever in infinite space, they spoke of the Infinite Dyad'.

There are ten pairs of opposites corresponding with odd and even numbers (odd, even; male, female; light, dark; etc.), and the opposites are 'fitted together' by adjustment (*ἁρμονία*, *harmonia*). The name 'harmonia' has not the special meaning of musical 'harmony', for which the correct name is symphōnia (*συμφωνία*), although it includes it as a special case. The original meaning was fitting together by some kind of joint, as in glued timber or bricks set in mortar; it also had other meanings.[13] That Pythagoras discovered experimentally any relation of frequencies to lengths and tensions of strings[14]

[1] In Zeller, (1), I, i[7], 429–45. [2] VS, i, 107. [3] Zeller, 557.

[4] Aristotle, *Metaphys.*, i, 5, 985*b*; xiii, 1–3, 1087*a*–1091*a*; Burnet, (1), 107; Deussen, (1), II, i, 60; Zeller, (1), I, i[7], 433, 446, 452, 455, 487: 'So wenig sich daher behaupten lässt, die Körper seien den Pythagoreern nicht Materielles . . . ebensowenig dürfen wir umgekehrt schliessen, die Zahlen müssen etwas Körperliches sein . . . Körpern und Zahlen wird unmittelbar identisch gesetzt, ohne dass man die Unzulässigkeit dieses Verfahrens bemerkte.'

[5] *Somn. Scip.*, i, 5 f., ii, 1 f.; Thorndike, (1), i, 544. [6] (1), I, i[7], 483, 490. [7] (1), 290.

[8] (2), 8, 53, 57, 60, 241; CAH, iv, 576. [9] Burtt, 30, 41, 76.

[10] viii, 25; ed. Hicks, 1925, ii, 343. [11] Festugière, (1), iv, 18.

[12] *Metaphys.*, xiv, 6, 1092*b*.

[13] Partington, *Nature*, 1935, cxxxvi, 107. [14] Burnet, (2), 45 f.

is improbable; the relation is not simple and was first discovered by Mersenne in 1636.[1] Aristotle[2] says the Pythagoreans believed the heavenly bodies in their motions made sounds, but we are so used to them that they are inaudible. This 'harmony of the spheres', and the comparison of the seven planets with the seven strings of a lyre, are later developments.[3]

The discovery of incommensurable numbers, revealed by the ratio of the lengths of the diagonal and side of a square (perhaps discovered by Pythagoras himself, but fully understood first by Theaitetos) was a serious difficulty in the system of number ratios. Frank[4] argued that the mathematical speculations are not due to the followers of Pythagoras (who remained a religious sect) but to a school flourishing in S. Italy about 400 B.C., Aristotle's 'so called Pythagoreans'. Tradition made Philolaos of Tarentum (fl. *c.* 430 B.C.) first publish the Pythagorean mathematics, his book influencing Plato,[5] but the authenticity of the fragments attributed to him[6] is disputed. They have been attributed to a member of Plato's school, perhaps Speusippos (fl. *c.* 350 B.C.),[7] or an anonymous Pythagorean of the 4 cent. B.C.,[8] or Archytas of Tarentum (fl. *c.* 360 B.C.), a pupil of Philolaos and friend of Plato.[9] The famous five regular solids and their relation with the elements have been attributed to Philolaos:

cube = earth   tetrahedron = fire   octahedron = air
icosahedron = water   dodecahedron = ether (?)

Although the ether (*αἰθήρ*) may have been known to the old Pythagoreans, it first appears as an 'element' in the *Epinomis* attributed to Plato (see p. 67).[10] Philolaos[11] says: 'the bodies (*σώματα*) of the sphere are five: those in the sphere, fire, water, earth, and air (*ἀήρ*), and the fifth is the *ὁλκάς*.' The meaning of *ὁλκάς* is the hull of a ship, and as a ship carries merchandise in its hold, so the *ὁλκάς* carries the cosmos. Philolaos speaks of a 'fifth (*πέμπτον*)' but does not identify it. Archytas says the outer zone was *pneuma* (*πνεῦμα*), from which the world drew its breath.[12] The identification of the five regular solids with the elements first definitely appears in Plato (see p. 55).[13]

The Pythagoreans knew empirically[14] the cube, tetrahedron, and dodecahedron (from the shape of North Italian pyrites crystals?).[15] The mathematical constructions

[1] Rosenberger, i, 9; ii, 35, 270.
[2] *De cœlo*, ii, 9, 290*b*.
[3] Burnet, (1), 307; Freeman, (1), 1949, 253; T. H. Martin, i, 383 f.; ii, 36 f.; Zeller, (1), I, i⁷, 537.
[4] 1923, 12, 31, 59, 69, 128, 134, 150, 219.
[5] Baeumker, 39; Burnet, (1), 277; Deussen, (1), II, i, 55; Howald, in Sudhoff, (1), 63; J. Stenzel, *Zahl und Gestalt bei Platon und Aristoteles*, 2 ed., Leipzig and Berlin, 1933; Zeller, (1), I, i⁷, 445.
[6] Freeman, (2), 73, 78; A. Rohr, *De Philolai Fregmente περὶ ψυχῆς*, Leipzig, 1874; VS, i, 398.
[7] Frank, 139, 143, 275, 333.
[8] Burnet, (1), 284; A. E. Taylor, (1), 40; Zeller, (1), I, i⁷, 484, 513.
[9] Frank, 139, 143, 263, 275, 317; Freeman, (1), 1949, 220, 245; Goebel, 140–75; Scoon, 339; Ueberweg, (1), i, 65; Wellmann, PW, ii, 600.
[10] Frank, 318; Gilbert, 77 f., 83; Wellmann, *Archeion*, 1929, xi, 160.
[11] VS, i, 412.
[12] Zeller, (1), I, i⁷, 543.
[13] Burnet, (1), 292.
[14] Nestle, in Zeller, (1), I, i⁷, 515; E. Sachs, 46, 70, 185.
[15] F. Lindemann, *Sitzb. Bayer. Akad., math.-phys. Kl.*, 1896, xxvi, 625; Sachs, 84.

were first given by Theaitetos, from whom (not Philolaos) Plato in the *Timaios* took over the five regular solids, relating four of them to the four elements. Aristotle first associated the dodecahedron with the ether, perhaps from Philolaos. The idea of the seven planets, tones, vowels, etc., as one of stages, the last being νοῦς, but followed by others, completed in the tenth, ἀγαθόν (the good), is also Platonic. The order of the planets in Philolaos is the same as in the *Epinomis*.[1]

Philolaos said 'things which were alike and related needed no harmony, but things which were unlike, unrelated, and unequally arranged are necessarily fastened together by such a harmony, through which they are destined to endure in the universe'.[2]

Diogenes Laertios[3] makes the Pythagoreans use ether (αἰθήρ) as a substrate of elementary qualities: air is α. ψυχρός (moist ether), fire α. θερμός (hot ether), water α. παχύς (coarse ether); earth as α. ξηρός (dry ether) is not given but implied. Transformation of one element into another is not due (as the Ionians thought) to qualitative change (ἀλλοίωσις, *alloiosis*) but to a quantitative change (γένεσις, *genesis*) produced by the coming together or sifting out of material particles. Obscure relations between numbers and properties (afterwards called ποιότης, *poiotes*), colours, etc., were postulated.[4]

Philolaos taught that the human body is composed of the hot element only, expelling some of it by breathing air after birth and so cooling itself. Phlegm is a hot element, not cold as others said, and the cause of fever (φλέγμα was fire or flame in Homer and inflammation in Hippokrates); bile is a 'fluid of the flesh' and is useless.[5] He formulated the theory of three souls in man: the vegetative spirits (shared by all living things) situated in the navel, the animal spirits (shared with beasts) giving sensation and movement and situated in the heart, and the rational spirit (peculiar to man) located in the brain. This corresponds with the (probably later) division of the soul into intelligence (νοῦς), will (θυμός) and mind (φρένες, peculiar to man).[6] The motes in the sunbeam are alive and have souls, since they move without wind.[7] Philolaos transmitted much number mysticism, e.g. in relation with parts of the universe, and the doctrine that this has a central fire (not the Sun) around which the planets revolve, with a Counter-Earth, inhabited like the Moon.[8]

Other Pythagoreans were Timaios of Lokroi (perhaps only an invention of Plato's) and Okellos of Lukania (the work περὶ τῆς τοῦ παντὸς φύσεως, attributed to whom, is a forgery of *c.* 150 B.C.).[9] Ekphantos of Syracuse (date uncertain) is said to have taught that the primary bodies (atoms?) are indivisible, have three differences (size, shape, and force; μέγεθος, σχῆμα, δύναμιν) and move not by weight or impact but by divine power, mind, or soul.[10]

[1] Howald, in Sudhoff, (1), 63; Scoon, 183.
[2] Freeman, (2), 74, 77; Scoon, 133 f., 330, 339 f.; VS, i, 419. Scoon thought Philolaos made 'harmony' a cosmic force, holding a body together like an outer skin; the form, shape, and size of an individual body, consisting of the four elements, constitute its 'number'. The action of 'harmony' is not mechanical but intelligent, like *nous* in Anaxagoras (p. 22).
[3] viii, 28; A. Delatte, 212.
[4] Deussen, (1), II, i, 63; Gilbert, 266.
[5] Freeman, (1), 1949, 224.
[6] Burnet, (2), 42; Ueberweg, (1), i, 71; Zeller, (1), I, i[7], 555.
[7] Freeman, (1), 1949, 253.
[8] Freeman, (1), 1949, 224.
[9] Beutler, PW, xxxiv, 2362.
[10] Hippolytos, *Refut.*, i, 15; (1), 30; VS, ii, 442; Freeman, (1), 1949, 241.

The Eleatic School

Xenophanes of Kolophon (fl. 530 B.C.) speaks of geological phenomena and fossils. There is no good evidence that he visited Egypt, but he travelled over Greece and went to Sicily and Syracuse. He mentions Pythagoras and his doctrine of transmigration. Although he gave the impetus to the founding of the Eleatic School his own contribution is hard to define. Aëtios reports that he said 'from earth is all and to earth will all be at the end'; Simplikios that 'earth and water is all which is and grows', and Sextus Empiricus 'we are all born from earth and water'.[1] But Aristotle[2] says no early physicist took earth as the primary substance, as it was too coarse-grained. Xenophanes said the earth is boundless below and will ultimately perish. The heavenly bodies are ignited moist exhalations from the earth. Living creatures are formed from earth and water as mud; the universe was once all mud and will become mud again. The sea became salt owing to water trickling through the earth, as we see from the walls of caves (stalactites ?). Xenophanes noticed phosphorescence and volcanic phenomena; fossils he called 'imprints (πλάκες)' made by living creatures and then dried in the mud.[3]

Other accounts say that Xenophanes taught that earth changes into water, air, and fire, and these back into earth by changes ἄνω καὶ κάτω,[4] and that he identified the deity with the One.[5] The words ἓν τὸ ὄν καί πᾶν attributed to Xenophanes have been supposed to mean 'being is one and all'.[6] He is said[7] to have first identified the soul (ψυχή) with *pneuma* (πνεῦμα), which is air (ἀήρ) because it is moved, and the soul is the principle of motion.

On the basis of ideas of Xenophanes the Eleatic School was founded by Parmenides of Elea (fl. *c.* 475 B.C.).[8]

He taught that 'What is (τὸ ὄν)' is a finite motionless material plenum, uncreated and indestructible, with no empty space in or beyond it, a 'thing in itself' and what we call 'matter'. There is only one 'One' which is everything (τὸ ἓν τὸ πᾶν τὸ ὄν). It is not divisible, since it is all alike. If Parmenides regarded this as a motionless sphere,[9] this is hard to reconcile with a plenum with no space *outside* it. Frank[10] thought Parmenides' earth was not spherical, since στρογγύλος, a word he first used, means 'curved' rather than 'spherical', and he probably meant a flat circular disc. He seems to have been the first to divide the earth into zones (a torrid, two frigid, and two intermediate inhabited).[11]

Earth and fire are the most important elements,[12] water and air being

[1] VS, i, 136. [2] *Metaphys.*, i, 8, 989 a 5.
[3] Baeumker, 46; Burnet, (1), 112; Deussen, (1), II, i, 71; Freeman, (1), 1949, 88; (2), 20; Gilbert, 86 f., 94–6; Goebel, 79, 84; Gomperz, (2), i, 155; E. Meyer, (1), ii, 761, 820; Robin, 79; Ueberweg, (1), i, 75; Zeller, (1), I, i[7], 640.
[4] Gilbert, 94 f. [5] Aristotle, *Metaphys.*, i, 5; 986*b*.
[6] Deussen, (1), II, i, 74; *id.*, I, i, 118, 145 (Indian parallels).
[7] Rohde, ii, 162, 258.
[8] Baeumker, 50; Burnet, (1), 169; Cornford, (2), 28; Deussen, (1), II, i, 67, 82; Diels, (5); Freeman, (1), 1949, 140; *id.*, (2), 20, 41; Gilbert, 90 f.; Goebel, 93; J. E. Raven, *Pythagoreans and Eleatics*, Cambridge, 1948; Reinhardt, *Parmenides*, Bonn, 1916; Scoon, 126; Ueberweg, (1), i, 74; VS, 1951, i, 217 f.; Windelband, 37; Zeller, (1), I, i[7], 679, 701, 726.
[9] C. Bailey, (1), 25–6. [10] 1923, 198 f.
[11] Tozer, 1896, 179. [12] Aristotle, *De gen. et corr.*, i, 3, 318*b*.

indefinite intermediate states. Cold is a negation of heat, unless both are merely relative forms of appearance.[1] The 'opposites' are personified as male (ἄρρεν, ἄρσεν) and female (θῆλυ), and they 'mix (μιγνύειν)'. The female is 'warmer' than the male (Empedokles said the reverse).[2] Parmenides' actual words are 'everything is full at once of light and dark night, both equal, since neither has ought to do with the other',[3] which implies that fire is one 'element' (a name not yet used), and Aristotle[4] said the other was earth. Man, like everything else, is composed of the warm and the cold (?) and death is caused by removal of the warm.[5]

In the middle of the way is the goddess (probably Necessity) who steers the course of all things — an Orphic idea.[6] Thought and being are one and the same (τὸ γὰρ αὐτὸ νοεῖν ἐστίν τε καὶ εἶναι).[7] Parmenides first used *logos* (λόγος) in the sense of dialectical argument; he started with the intuitional concept of what 'is'.[8]

Many teachings of Parmenides, such as the descent of the soul from heaven and its reascent after death, the transformation of souls into stars, the interaction of male and female, etc., are perhaps derived from Orphicism and Mystery Religions, which in turn borrowed from the East.[9] Zeno of Elea, a pupil of Parmenides, visited Athens with him about 450 B.C. and read his book *Attacks* (Ἐπιχειρήματα). It greatly impressed Plato.[10] He taught that 'being [is] one and all' (ἓν τὸ ὂν καὶ πᾶν), or 'one [is] the all' (ἓν τὸ πᾶν); the verb 'is' must be omitted, since it postulates existence. Being and Not-Being are the fundamentals. The universe is a spherical, infinite, eternal, uncreated and imperishable, immovable, mass of matter. Motion, change, variety, life, death, and everything we think we know through the senses, are illusory. Since the universe is full of matter, there is no vacuum and nowhere for anything to move, and nothing does move.

Zeno asked: 'Does a body move in the space in which it is, or in the space in which it is not?' Diodoros Chronos of Iasos (fl. *c.* 300 B.C.), who belonged to the Megaric school, argued that 'a moving thing is either where it is or where it is not; but a thing rests where it is, and where it is not it can neither act nor suffer; therefore nothing moves'.[11] Achilles will never overtake a tortoise. The distances get shorter and shorter but never become zero. Aristotle[12] refuted some of Zeno's fallacies, others still trouble philosophers.

The indestructibility of matter is clearly stated by Melissos of Samos (fl. 440 B.C.): 'it is impossible for something to come into being out of nothing (οὐδαμὰ ἂν γένοιτο οὐδὲν ἐκ μηδενός, *ex nihil nihil fit*).' Since he believed that

[1] Deussen, (1), II, i, 82; Diels, (5), 100; Gilbert, 102.
[2] Burnet, (1), 186, 192, 215; Diels, (5), 42, 44, 114; Zeller, (1), I, ii[6], 990.
[3] Burnet, (1), 177. [4] *Physics*, i, 5, 188*a*; Burnet, (1), 185, 223; Gilbert, 101.
[5] Burnet, (1), 192; Diogenes Laertios, ix, tr. Yonge, 1891, 384, gives both cold and earth as the second principle; Tertullian, *De Anima*, 43; Waszink, 58, 462, says Parmenides and Empedokles taught that sleep serves to cool the body.
[6] Burnet, (1), 190; Deussen, (1), II, i, 87; Guthrie, (1), 1952, 231.
[7] Ueberweg, (1), i, 83–4. [8] Scoon, 63.
[9] Pfeiffer, 124 f., 182 f.; Robin, 89.
[10] C. Bailey, (1), 26; Burnet, (1), 169, 182, 310; Deussen, (1), II, i, 74; Frank, 198; Freeman, (1), 1949, 153; (2), 47; Gilbert, 86; Goebel, 110; H. D. P. Lee, *Zeno of Elea*, Cambridge, 1936; VS, i, 247; Zeller, (1), I, i[7], 741.
[11] Rodwell, (1), 28; Schmitz, DBM, i, 1015. [12] *Phys.*, vi, 2 f., 233a, f.

no change at all could occur, this is hardly the same as our modern law of indestructibility of matter (in the narrow, chemical, sense). For this, we must go to the Atomists, although it is clearly implied in Empedokles (p. 20). Melissos held the same theory of the plenum and the absence of motion as Zeno; all things are one (ἓν τὸ πᾶν).[1]

That there could be motion without void, as the sea by its waves can expand and overflow the shore, was recognised by Xuthos (fl. 450 B.C. ?), a Pythagorean,[2] and Aristotle knew vortex motion in a plenum. Rarefaction and condensation, producing rare and dense bodies, involve motion, and hence, Melissos said, qualitative changes are impossible. 'If things are many (as Anaxagoras said) they must be such as the One is',[3] which is not (as Zeller and Burnet thought) an anticipation of the atomists, since Melissos did not accept empty space. Aristotle[4] said Parmenides and Melissos were not physicists any more than Plato, but Anaxagoras, Anaximenes, and Empedokles were, but the real turning point came with the atomic theory of Leukippos and Demokritos (see p. 38).

Empedokles

Empedokles of Akragas (Agrigentum, in Sicily), (492–432 B.C.), who is said to have been a pupil of Parmenides (p. 15), was a versatile man: poet, politician, mystic, philosopher and physician (he founded the Sicilian school of medicine), also something of a charlatan: he 'went about in silk robes and copper sandals', called himself a god, and vanished during a sacrifice, or, alternatively, jumped into the crater of Etna, expecting to return. In the 1–2 cents. A.D. he was the object of philosophic satire and ridicule, and he is often quoted by earlier Christian and gnostic authors.[5] He wrote two poems: (i) *On Nature* (περὶ φύσεως), and (ii) *Purifications* (καθάρμοι) containing Orphic ideas. A medical work (Ἰατρίκος λόγος) is attributed to him.[6] He appealed to facts, was more interested in detail than his predecessors, and made experiments (p. 18), which gave him a bad reputation as a magician.[7] Yet he held that the criterion of truth was not ultimately the senses but the 'right word' (ὀρθὸς λόγος), part of which was divine (his own inspiration) and might not be revealed, but part was mortal and capable of revelation.[8]

The earlier Ionian philosophers chose as the basis of the material world one or other of the four 'elements' fire, air, water, and (rarely) earth. Empedokles' outstanding contribution was to take all four, and this 'theory of the four elements' lasted until the end of the 18 cent. A.D. Such vitality is never accidental.

[1] Burnet, (1), 320; Freeman, (1), 1949, 164; (2), 48; Gilbert, 104; Goebel, 124; Gomperz, (2), i, 184, 550; Robin, 95; VS, i, 258; Zeller, (1), I, i[7], 765, 780.
[2] Freeman, (1), 1949, 205; VS, i, 376.
[3] Burnet, (1), 323–4. [4] *Physics*, i, 5–9, 188*a*–192*b*.
[5] C. Bailey, (1), i, 28; Baeumker, 67; Burnet, (1), 197; Cornford, CAH, iv, 563; Deussen, (1), II, i, 106; Freeman, (1), 1949, 172; Gilbert, 105; Goebel, 191; Kranz, *Hermes*, 1912, xlvii, 18; Scoon, 82; Thiele, *Hermes*, 1897, xxxii, 68; Ueberweg, (1), i, 91; Waszink, 384; Wellmann, PW, v, 2508; J. Zafiropulo, *Empédocle d'Agrigente*, 1953; Zeller, (1), I, ii[6], 939–1038.
[6] Burnet, (1), 204; Freeman, (2), 51; W. E. Leonard, Chicago, 1908 (verse tr.); VS, i, 276.
[7] A 10-cent. Spanish-Jewish work on magic was attributed to him: Karppe, 362.
[8] C. Bailey, (1), 60.

Empedokles first demonstrated that air is corporeal by an experiment with a *klepsydra* (κλεψύδρα), a metal pipette-like vessel used in the kitchen.[1] When dipped in water with the upper tube closed with a finger, water did not enter; when filled with water and the upper tube closed, water did not run out.[2] He related this with an up and down movement of the blood in the vessels in the body, and supposed that air enters through the pores of the skin.

Empedokles does not call the primary bodies 'elements' (στοιχεῖα, *stoicheia*), a name first used by Plato, but 'roots (ῥιζώματα, *rhizomata*)', introduced under the names of four divinities,[3] 'four roots of things: bright Zeus, and life-bearing Hera, and Aidoneus, and Nestis, who causes a mortal spring of moisture to flow with her tears.' Nestis (a Sicilian water-goddess)[4] typified water, but the other identifications vary:

Zeus: air (Burnet), fire (Windelband, Ueberweg, Freeman), fire or ether (Diels).
Aidoneus: air (Windelband, Kranz), earth (Zeller, Ueberweg, Freeman), earth or air (Diels), fire (Burnet).
Hera: air (Zeller, Deussen — 'giver of life', Ueberweg, Freeman), earth (Windelband, Burnet, Kranz), air or earth (Diels).

The association of the elements with divinities may imply Iranian influence,[5] since Herodotos[6] says the Persians worshipped the earth, fire, water, and wind (not air). An Indian origin is also possible.[7] Later writers[8] say the Egyptians associated each of the four elements with a god and goddess, and taught that each element has an active male and a passive female form, thus making eight divinities (an *ogdoad*):

active	air = wind	*passive*	air = atmosphere
	fire = flame		fire = light
	water = sea		water = other forms of water
	earth = rock		earth = clay, cultivated soil

Hippolytos[9] said the Pythagoreans and Egyptians took fire and water as male, and air and earth as female, Diodoros Siculus[10] that the Egyptians deified the five elements, spirit (ether), air, water, fire, and earth, these being created by Osiris (hot and active) and Isis (cold and passive), 'both having something of air'. The Egyptians and Babylonians had some such ideas[11] and four pairs of gods occur in the very old Egyptian Pyramid Texts,[12] but it was only at a time when the Greek four elements were known in Egypt that they were associated with the much older ogdoad of gods, perhaps in the Ptolemaic period and under later Stoic influence.[13]

The four elements were separately recognised by Homer but only as great aggregates on the basis of popular legends.[14] The number 4 may have been

[1] Theophrastos, *De sudore*, 25; Diels, (3), 192; Last, *Class. Quart.*, 1924, xviii, 169; Ogle, (1), 81, 120; Powell, *Class. Quart.*, 1923, xvii, 172; Thalheim, PW, xi, 807 (5 cent. B.C.).
[2] Aristotle, *De respir.*, vii, 473*b*; Freeman, (2), 62; VS, i, 348.
[3] Thiele, *Hermes*, 1897, xxxii, 68.
[4] Wagner, Ro., iii, 287.
[5] Gomperz, (2), i, 444; Reitzenstein, (7), 156, 165, 174, 178, 204, 215.
[6] i, 131.
[7] Deussen, (1), I, iii, 65, 597, 626, 647; Garbe, (1), 86 f.
[8] Seneca, *Quaest. Nat.*, iii, 14; Iamblichos, *De Myst.*, viii, 3.
[9] *Refut.*, i, 2; iv, 43–4; (1), 12, 110.
[10] i, 1, 10; T. L. Davis, *J. Chem. Educ.*, 1935, xii, 3; Diels, (2), 44; Dieterich, (1), 60.
[11] Brugsch, (1), 1885, i, 29; Budge, (1), 1904, i, 282 f.
[12] G. Maspero, (1), 142; Reitzenstein, (1), 1901, 77, 97; W. Scott, (1), iv, 63.
[13] Burnet, (1), 229; J. Kroll, (1), 184; Lepsius, (2), 181, 197, 220.
[14] Gilbert, 23.

suggested to Empedokles by the Pythagorean *tetraktys* (p. 12), or the medical 4 humours (see p. 29),[1] or on the basis of the observation that when wood burns flame (fire) and smoke (air) escape, moisture (water) bubbles out, and ashes (earth) remain.[2] Empedokles thought that each element is potentially contained in every other, transformation occurring in the sense of the 'natural place' of each in the world: fire at the top, air, water, and earth below, in this order. Neighbouring elements were most easily and directly transformed, e.g. air to fire by rarefaction, air to water and water to earth by condensation. The whole cosmos could then be regarded as the result of a uniform evolution of a single, divine, substrate or 'matter'.[3]

Empedokles[4] also names the elements as such calling fire 'the Sun' and air 'ether (αἰθήρ)' rather than ἀήρ — which perhaps means mist or moist vapour.[5] He proved experimentally (see p. 18) that air is not empty space or a condensible vapour. The four elements are uncreated, are not mixtures of other things, and account for all substances. No element is predominant, all have equal importance (ἰσοτής, *isotes*); if not identical with, they are at least very closely related to, the four 'opposites' (later called qualities): cold, heat, moisture, and dryness; fire and air are hot and dry, water and earth cold and moist. They are all composed of small particles, which can mix together but do not penetrate one another. Things are formed by the mixing (μῖξις, *mixis*) or separation (διάλλαξις, *diallaxis*, 'shifting of positions', Bailey) of the particles, which retain their identities in the mixture (μίγμα or μεῖγμα, *migma*; 'amalgam' = *al migma*, in Arabic, and *migma* is used in this sense by Zosimos)[6] and can be separated again from it. The proportions in the mixture can vary according to chance (τύχη, *tyché*), giving rise to qualitative differences.

In a mixture the particles lie side by side but mix (κερίεσθαι, μίσγεσθαι).[7] Galen[8] says a mixture of verdigris (ἰός), copper ore (χαλκῖτις), zinc ore (καδμία), and vitriol (μίσυ), so finely ground together that no one body can be taken up without the others, is like 'a mixture of the four elements (τῶν τεσσαρων στοιχείων)', and Empedokles, a physician, may have given this example. A fragment of Empedokles is: 'copper mixed with tin (καττιτέρῳ μιχθέντα τὸν χαλκόν)',[9] quoted from him by Aristotle,[10] who did not understand what Empedokles meant by saying the copper becomes 'hard' because 'the hollows of one fit into the densities of the other (τὰ κοῖλα τοῖς πυκνοῖς ἀλλήλων)', as is also the case in the mixing of wine and water, and in the formation of a mule from the 'soft' seed of the horse and the 'dense (πυκνόν)' seed of the ass.

[1] Diels, (2), 15; Farrington, i, 51; Scoon, 82 f.
[2] Aristotle, *De coelo*, iii, 3; *Meteor.*, iv, 9; see Boyle, Vol. II, p. 505.
[3] Burnet, (1), 12, 49; Diels, (2), 14, 17, 21; Gilbert, 23, 43 f., 54 f., 58, 63.
[4] Freeman, (1), 1948, 59; VS, i, 338.
[5] Burnet, (1), 228; Zeller, (1), I, ii[6], 950, says not.
[6] Berthelot, (2), ii, 197, 15.
[7] Aristotle, *De coelo*, iii, 7, 305*b* (q. Empedokles); cf. *De gen. et corr.*, ii, 6, 333*b*; Kranz, *Hermes*, 1912, xlvii, 18.
[8] Ed. Kühn, xv, 32 (q. Empedokles, but Reinhardt, (2), 26, says it is not from Empedokles).
[9] Burnet, (1), 218.
[10] *De gen. animal.*, ii, 747*b*: not 'bronze' mixed with tin, as Peck, ed. Aristotle's *Generation of Animals*, Loeb, 1943, 250, says.

Empedokles compared the four elements with the four colours (mentioned by Herakleitos, p. 8), perhaps following Polygnotos (475–447 B.C.), the contemporary painter, who is said to have introduced ochre-yellow in addition to black, white, and red. The Pythagoreans confined their discussions to black and white, but Aristotle says they used the name 'colour' for surface; Aristotle tried to derive seven colours (Newton's spectrum) from the four.[1] Empedokles speaks of linen dyed with saffron.[2]

Empedokles says of the four elements: 'nothing comes into being besides these, nor do they pass away . . . but, running through one another (δι' ἀλλήλων δὲ θέοντα), they become now this, now that, and like things evermore (ἠνεκὲς αἰὲν ὁμοῖα).'[3] His theory of four 'elements' in place of one primary matter was the beginning of chemical rather than philosophical ideas.[4] Lucretius[5] criticised the theory on the grounds that the four elements are too 'soft' (*mollia*) to resist destruction, and, as they are supposed to change into each other, they are not really elements. But Empedokles said that each element consists of its own kind of unchangeable everlasting particles clustered together, with pores (πόροι) between them. Bodies send out effluxes (ἀπορροιαί) which can enter appropriate pores of other bodies, producing mixture and also sensation.[6]

The particles are moved by two external agencies, love (φιλία, *philia*) of harmony (ἁρμονια) which collects them, and strife (νεῖκος, *neikos*) which separates them.[7] The particles, originally uniformly mixed in chaos in an infinite sphere (σφαῖρος), were separated by strife in virtue of necessity (ἀναγκη, *ananké*); then love entered and collected the parts into vortices. Love and strife were material, or of a material nature, not attractive and repulsive forces.[8] 'Sweet lays hold of sweet, and bitter rushes to bitter, acid comes to acid, and warm couples with warm.'[9] The coupling of like with like produces the accretion of material in the nutrition of plants and animals.

Things mix easily when the pores (πόροι) are similar in size. This depends on the character of bodies, not on external forces or attraction. 'Water fits better into wine but not into oil.' The product may be different, as when the soft metals copper and tin form hard bronze.[10] 'Wine is water from the bark

[1] Deussen, (1), II, i, 111; Gilbert, 113, 339; Kranz; VS, i, 462.

[2] Burnet, (1), 218; Diels, VS, i, 345, altered κρόκον (saffron) in the MSS. to κόκκος (scarlet) and read 'with the colour byssos is mixed the blue of the elderberry' (βύσσωι δὲ γλαυκῆς κόκκος καταμίσγεται ἀκτῆς), but the fragment is from Plutarch, *De defect. orac.*, 41; *Opera*, 1929, iii, 116, and the MS. gives κρόκον, and ἀκτίς, ray, and the correct reading is surely 'the ray of bright saffron-yellow mingles with the linen': Freeman, (2), 61.

[3] Burnet, (1), 208; VS, i, 318.

[4] E. V. Arnold, 41.

[5] i, 753 f., 763 f.

[6] Burnet, (1), 233 f.; Gilbert, 107; Gomperz, (2), i, 444; Ueberweg, (1), i, 95; Zeller, (1), I, ii[6], 956. C. Bailey, (1), 30, 53, says Empedokles regarded space as *filled* with matter and the ἀπορροιαί are also material and enter pores or cracks in the other body.

[7] Love (Eros) had been introduced from Hesiod into philosophy by Parmenides; Freeman, (1), 1949, 151.

[8] Deussen, (1), II, i, 120; Gilbert, 122.

[9] Burnet, (1), 218; who says, 233, 245: 'Love . . . produces an attraction of *unlikes*' and is different from the 'attraction of like for like, to which he also attributed an important part in the formation of the world'; also, 240, 'Love . . . at present, is still able to form combinations of elements.' Nestle, in Zeller, (1), I, ii[6], 963, criticised Burnet's views.

[10] VS, i, 198.

concocted in the wood.'[1] Empedokles said the taste of the vine is due to particles of earth.[2] The warmth of strong wine is due to its fire content. The fermentation of wine, animal digestion, and (perhaps) the curdling of milk by fig-juice, are examples of putrefaction (σῆψις; 'dissolution' in Freeman, but it never seemed to have this meaning).

The sea is the sweat of the earth (γῆς ἱδρῶτα θάλασσαν); salt is solidified by the pressure of the forceful rays of the sun; fish are nourished by the fresh water contained in the sea.[3] Trees differ on account of the earth out of which they spring; the roots are increased wholly by earth with its mixture with water, while the shoots owe their growth to the air (αἰθήρ). Plants have intelligence. Trees (like animals in the beginning) are either male and female together or divided into male and female. The evergreen or deciduous nature depends on the amount of moisture in them. Fruits are 'residues' from water and fire, like animal excrements. Living animals can be generated when heat and moisture undergo a kind of corruption. Blood is connected with breathing and is the cause of milk, sweat, and tears. The soul is formed from the elements and is divine.

Empedokles had some idea of definite proportions of the elements in bodies: bone consists of 2 parts of water, 4 of fire, and 2 (or 8) of earth, flesh and blood nearly the same. The correct 'mixture' is important for health (bodily and mental) and the bodily functions.[4] He speaks of 'all the drugs (φάρμακα)' and says: 'keep away entirely from laurel leaves' (poisonous ?).[5]

The theory of the 4 elements was adopted by Philistion of Lokroi (*c.* 427–347 B.C.) and Diokles of Karystos (400–350 B.C.).[6] Menestor (fl. 450 B.C.) followed Empedokles in some views; he began to apply the theory of opposites and right mixture to botany (he is reported by Theophrastos); hot and cold plants grow best in appropriate environments, ivy being the hottest in composition. Taste is produced by a process of fermentation (σῆψις, sepsis) resolving plant juices into their component parts.[7] Hippon (or Hipponax) of Samos, a Pythagorean (fl. 450 B.C.), a physician in Athens, followed Thales in taking as the substrate 'the moist' (τὸ ὑγρόν), either water or air. Fire, the hot, was generated from water, which it then overcame and so created the universe. The life-principle or soul is derived from the cold element, water, since the seed from which life developed is moist. He explained physiological and pathological processes in terms of humidification or desiccation. Excess or deficiency of moisture causes disease. He opposed Herakleitos. He studied physiology and botany. He, and Kallimachos (fl. 264 B.C.), spoke of vinegar as dead wine (νεκρός, *nekros*, ἀλίβας, *alibas*), perhaps because it was cold.[8] Ion of Chios (fl. 452–421 B.C.) said 'everything is three', apparently

[1] Burnet, (1), 216; VS, i, 340; Eisler, (3), 134; Gilbert, 213, 342. The fragment is from Plutarch, *Quaest. Nat.*, ii; *Morals*, tr. Holland, f°, 1603:

'When in vine wood the water putrefies
It turns to wine, whiles under barke it lies.'

Holland says 'concotion seemeth to be a kind of putrefaction' and Empedokles seems to have had this idea: ἡ δε πέψις ἔοικεν εἶναι σῆψις. Burnet read 'putrefied', Gilbert, and Diels, VS i, 340, 'vergorenes (σαπὲν)'.

[2] Burnet, (1), 241. Eisler says intoxicating drinks are made from juices of trees.

[3] VS, i, 295, 332.

[4] Deussen, (1), II, i, 121; Freeman, (2), 96, 98; Gilbert, 122; Goebel, 196; Zeller, (1), I, ii^{6}, 986 f.

[5] VS, i, 353, 365.

[6] W. Jaeger, (1), 212; Wellmann, (1), 74.

[7] Freeman, (1), 1949, 204.

[8] Freeman, (1), 1949, 209; Gomperz, (1), i, 303; Immisch, *A. Rel.*, 1911, xiv, 449; VS, i, 385; Wellmann, PW, xvi, 1889; Zeller, (1), I, i^{7}, 333.

not three elements.[1] Oinopides of Chios (fl. *c.* 425 B.C.) took fire and air (πῦρ καὶ ἀέρα) as elements.[2]

ANAXAGORAS

Anaxagoras of Klazomenai (near Smyrna) (*c.* 500–428 B.C.), a Persian subject, came to Athens but was later exiled. He probably learnt from refugees from Miletus who had spread over Ionia in 494 B.C.[3] He may have been the first important philosopher to teach in Athens. His book *On Nature* (περὶ φύσεως, *peri physeos*) sold in Athens for a drachma (about 4/–). He died in Lampsakos. Anaxagoras was a kindly and serious man; he is said to have declined a visit from Demokritos (forty years his junior), which displeased the latter. The fragments of Anaxagoras's teaching, although at first sight clear, have been much discussed.[4]

He assumed that apparent change is due to the mixing (σύμμιξις, *symmixis*) and separation (διάκρισις, *diakrisis*) of an infinite number of indestructible particles which he called seeds (σπέρματα, *spermata*) or things (χρήματα, *chremata*), and that there is no real creation or destruction. The particles are exceedingly small and imperceptible except on coagulation. The coagulated particles are of fire, air, water, and earth, and other simpler substances, but even among these, such as earth or gold, no two are exactly alike. The four 'elements' are not simple unmixed bodies. Things are divisible without limit and retain their characteristics; gold is composed of little 'seeds' of gold, flesh of little fleshes, etc.; but the heart is not composed of little hearts but its flesh of little fleshes.

A substance like gold can be infinitely subdivided and the result, however small, will be a particle of gold.[5] The seeds are not atoms, since 'in the small there is no smallest but there is always a smaller'.[6] C. Bailey[7] thought, in opposition to Burnet,[8] that Anaxagoras had some idea of the difference between chemical combination (σύμμιξις, *symmixis*) as contrasted with simple mixture (σύγκρισις, *synkrisis*). In a 'mixture' (μίγμα, *migma*, or μεῖγμα, *meigma*, really what we call a 'compound'), the individual things cannot be distinguished, but they are there and influence the whole.

Aristotle[9] says Anaxagoras taught that 'every particle is a mixture (μῖγμα) in the same way as the whole (ὁμοίως τῷ παντὶ)'. Everything has in it seeds of everything else, 'all is in all', a panspermia (πανσπερμία), yet one material usually predominates. The primary matter is an amalgam (μίγμα, μεῖγμα) of all kinds of seeds.

Aristotle[10] calls the 'seeds' of Anaxagoras *homoiomeré* (ὁμοιομερῆ), Simpli-

[1] Freeman, (1), 1949, 206; (2), 70; VS, i, 375. [2] Freeman, (1), 1949, 215; VS, i, 393.
[3] Freeman, (1), 1949, 261; the dates given for his movements are doubtful.
[4] Baeumker, 73; C. Bailey, (1), 34 f., 537 f., 541; Burnet, (1), 130, 234, 264; F. M. Cleve, *The Philosophy of Anaxagoras*, New York, 1949; Cornford, CAH, iv, 569; *id. Class. Quart.*, 1930, xxiv, 14, 83; Deussen, (1), II, i, 124; Freeman, (1), 1949, 261; (2), 82; Gilbert, 126; Goebel, 226; Mabilleau, 237; Peck, *Class. Quart.*, 1931, xxv, 27, 112; Ueberweg, (1), i, 98; VS, ii, 5; J. Zafiropulo, *Anaxagore de Clazomène*, 1948; Zeller, (1), I, ii[6], 1195.
[5] Lucretius, i, 839 f.; cf. Plato 'it is better to call it gold', *Timaios*, 50B.
[6] VS, ii, 33. [7] (1), 546. [8] (1), 263.
[9] *Phys.*, iii, 4, 203*a*; ed. Prantl, (1), 116.
[10] *De gen. et corr.*, i, 1, 314*a*: ὁ μὲν γὰρ τὰ ὁμοιομερῆ στοιχεῖα; *De cœlo*, iii, 3, 302*a*: τὰ γὰρ ὁμοιομερῆ στοιχεῖα; in both cases naming Anaxagoras.

kios and Aëtios *homoiomerai* (ὁμοιομέραι); Lucretius[1] uses the singular *homoeomeria*, naming Anaxagoras. The names do not occur in the extant fragments, but some[2] think Anaxagoras called the 'seeds' ὁμοιομέρειαι, referred to his theory as the *homoeomeria*, and probably spoke of compounds as ὁμοιομερῆ; others[3] think the name was invented by Aristotle. Anaxagoras does not specifically mention inorganic 'mixtures', such as electrum (gold + silver) or bronze (copper + tin), but gives examples from organic materials, so that perhaps his theory is based on physiological facts, such as the formation of parts of the body from food. Galen[4] says food does not contain blood, which is formed in the body.

The elementary particles are alike, but not exactly alike; yet each contains a portion of everything. A seed of an animal or plant is composite, containing the particles of all the substances which subsequently develop from it. This does not mean that a morsel of bread or of *anything*, if analysed, would be found to contain fragments of bone, flesh, hair, etc.; he says[5] 'the things in our cosmos are not separated off from one another with an axe'.

It was suggested[6] that Anaxagoras meant 'qualities' (hot-cold, wet-dry, light-dark, etc.) but Bailey assumed that he meant real material things, although the distinction would hardly have been appreciated in Anaxagoras's time.[7] Lucretius[8] said: 'if in wood flame lurks hidden, and smoke and ash, it must need be that logs are composed of things alien in kind', and this would imply the ultimate reversibility of all chemical changes:

$$\text{wood} + \text{oxygen} \rightleftharpoons \text{carbon dioxide} + \text{water} + \text{ash} + \text{heat}.$$

Lucretius[9] also asks how, if seeds are infinite in variety, bread eaten can be converted into flesh? Aristotle[10] said that if morsels of flesh could be taken out of water, the process would either stop at some point, when the water left would contain no flesh, or it would go on indefinitely, when all the water would be turned into flesh. If everything can change into everything else like this, alchemy would be possible.[11]

C. Bailey[12] thinks Anaxagoras meant that there is a portion (μοῖρα, *moira*) of *everything* in everything, but the seeds of it, which are infinitely divisible, are imperceptible; yet however small, all things are 'fused together' in each. In seeds of gold, the gold 'prevails', but they contain particles of other metals and other things.[13] When violent external forces are applied, as in eating bread, the alien seeds are 'separated out (ἐκκρίνεται, *enkrinetai*)' by 'breaking up (διάκρισις, *diakrisis*)', and join with seeds of like kind in the body to form a new compound. Bailey says the most important passage for Anaxagoras is in Simplikios:[14]

1 i, 830, 834.
2 C. Bailey, (1), 552 f.; Gomperz, (2), i, 557; Kranz, *Hermes*, 1912, xlvii, 18; Zeller, (1), I, ii[6], 1212.
3 Burnet, (1), 264; Freeman, (1), 1949, 266; Ross, (2), i, 132; Schleiermacher, in VS, ii, 18; Ueberweg, (1), i, 99.
4 *De nat. fac.*, ii, 18; Kühn, ii, 107.
5 Freeman, (2), 84.
6 Burnet, (1), 263; Freeman, (1), 1949, 266.
7 K. Joël, 572–3.
8 i, 871.
9 i, 859.
10 *Phys.*, i, 4, 187*b*.
11 Robin, 125.
12 (1), 541; Zeller, (1), I, ii[6], 1216.
13 Ueberweg, (2), i, 66.
14 VS, ii, 15.

ἀγένητα μὲν εἶναι καὶ ἄφθαρτα, φαίνεσθαι δὲ γινόμενα καὶ ἀπολλύμενα συγκρίσει καὶ διακρίσει μόνον, πάντων μὲν ἐν πᾶσιν ἐνόντων, ἑκάστου δὲ κατὰ τὸ ἐπικρατοῦν ἐν αὐτῳ̃ι χαρακτηριζομένου . . . ἐν παντὶ παντὸς μοῖρα ἔνεστι.

The meaning is that things are uncreated and imperishable, but they appear to come into being and pass away only owing to combination and separation, since all things are in all, and each receives its character owing to that which prevails in it. In everything there is a portion (*μοῖρα*) of everything and each single thing is and was manifestly that of which it has most in it.

Bailey[1] maintains (in opposition to Burnet) that Anaxagoras says that 'all things were formerly mixed together before they were separated apart'. Aëtios calls the particles 'portions capable of producing blood etc. (*μόιρια αἵματος γεννητικά*)'.

Cornford, on the assumption that Anaxagoras was 'answering' Parmenides, supposed that Aristotle had misunderstood the 'portion of everything in everything'. Anaxagoras did not think bread contains seeds of bread but of corn, water, etc., and since it forms flesh, bone, etc., it contains seeds of these but not of gold, for example, which it does not form. The four elements are not *homoeomerae*. Peck supposed that a seed is not static but capable, under the influence of *nous* (see below), and nourished by the 'opposites', of development and growth. As Bailey[2] said, there is no warrant for this assumption in any of the fragments or notices.

The central point of Bailey's interpretation is that Anaxagoras's idea of *μεῖγμα* or *σύμμιξις* is more like ours of a chemical compound than of a mechanical mixture (*σύγκρισις*); the individual things are in it in a sense, but from the nature of their fusion are not distinguishable (*χωριστά*); their presence in greater or smaller quantities influences the character of the whole.

If a white liquid is added drop by drop to a black liquid the eye cannot detect the change of colour and the sense-perceptions are limited. Yet where white is, black must also be, as in 'black water (*μέλαν ὕδωρ*)', which changes into white snow and vice versa.[3] Anaxagoras denied the existence of a vacuum.[4] Aristotle[5] says he taught that the pores of bodies contain air, repeated the *klepsydra* experiment (see p. 18), and demonstrated the existence of air by squeezing and stretching inflated wine-skins.

The seeds are moved by *νοῦς* (*nous*), the usual meanings of which in Greek are mind, purpose, reason, intellect, meaning; probably the best here is 'active mind'. It is 'unmixed', containing no portion of anything else, the finest and purest of things, standing apart from matter, of which it has complete knowledge and over which it has complete power. It is the source of motion and of life, in living things it is the soul.[6] Some (Adam, Drummond, Whittaker) regard it as immaterial, or 'spirit', in which case Anaxagoras was the first to separate spirit and body, but others (Bailey, Burnet, Deussen, Ueberweg, Zeller (an 'imponderable fluid' at least)) regard it as material, which is supported by Anaxagoras's description of it as 'the finest of things (*λεπτότατον*

[1] (1), 550. [2] (1), 543 f. [3] Goebel, 238; VS, ii, 29, 37.
[4] Zeller, (1), I, ii[6], 1220.
[5] *Phys.*, iv, 6, 213*b*.
[6] Adam, 260; C. Bailey, (1), 546; Burnet, (1), 267; Deussen, (1), II, i, 130; Drummond, i, 48; Gilbert, 129; Ueberweg, (1), i, 100; T. Whittaker, (1), 10; Zeller, (1), I, ii[6], 1220, 1228.

τε πάντων χρημάτων)'. He denied the existence of fate (εἱμαρμένη) or chance (τύχη).[1]

Anaxagoras assumed that at first the most heterogeneous substances were everywhere commingled. Then mind (νοῦς) worked upon it by a very rapid vortex motion (περιχωρεῖν), beginning in a point and spreading from this. In this way air (ἀήρ), which is dense, moist, cold, and dark, and ether (αἰθήρ), which is light, dry, warm, and bright, were separated.[2] Water was separated from air, earth from water, and from earth stones (ἐκ τῆς γῆς λίθοι), by the action of cold (ψυχροῦ). The muddy earth was then dried up by the sun, the remaining water becoming salty by evaporation.[3] The 'elements' separated were not pure and unmixed. The νοῦς in the mixture (μεῖγμα) is not fused with the material parts but separate, although it is capable of decomposing the 'mixture' into its seeds.[4] Plato[5] said that 'Anaxagoras made no use of reason and did not give the true causes for the regular arrangement of individuals, but proposed air, ether, water, and other unsuitable things as causes'; he introduced νοῦς only when his 'mechanical' principles failed.

Air, as proved by the klepsydra experiment, is material; this is also shown by its rise in heat, as is seen by the motes in it; it makes a sizzling sound as it rises. Lightning is the descent of fire from the upper ether as it comes through the clouds; thunder is the noise of its quenching. The saltness of the sea is due to its filtration through the earth, containing salt and soda, assisted by evaporation.[6]

There may be other worlds contemporary with ours, with men, plants, and animals, with their own suns, moons, and stars. Animals were created first by the fall of 'seed' from heaven (a Manichæan idea), afterwards by reproduction. The seeds of plants were washed down from the air by rain to the ground, where they took root. Plants have sensation, feel grief, and have a portion of *nous*, which (although mixed with nothing) is in things which have life but not necessarily intelligence. Plants as well as animals breathe.[7] White of egg is the embryo's food (ὄρνιθος γάλα, bird's milk).[8]

Fish breathe by blowing water from the gills and sucking in air from the mouth, since there is no vacuum. The worst human diseases are due to excess of bile, which escapes into the lungs and veins. Sense perceptions are due to the meeting of opposites. They cannot judge of absolute truth, but the senses must be used to arrive at truth; to see the invisible we must use the visible. Mind (νοῦς) alone knows everything. The soul is not immortal except as part of the universal mind; it does not temporarily leave the body in sleep.[9]

Archelaos (fl. 450 B.C.), perhaps from Miletus, a pupil of Anaxagoras, taught physical science at Athens; Sokrates was his pupil. He is said to have succeeded Anaxagoras as master of the school at Lampsakos. In his work (φυσιολογία, *physiologia*) he followed Anaxagoras, although some say he took air as the primary substance, from which fire and earth were formed by rarefaction and condensation; others say he started with earth. *Nous* separated air into active fire and passive water. The water partly evaporated to form air and partly gave a residue of earth. He denied that mind is

[1] Ueberweg, (2), i, 65.
[2] Aristotle, *Phys.*, viii, 1; 250*b* f., and commentary of Simplikios.
[3] C. Bailey, (1), 41; Scoon, 329; VS, ii, 5, 37, 40; Zeller, (1), I, ii[6], 1233.
[4] C. Bailey, (1), 543 f.
[5] *Phaidon*, 97*b*, *Works*, ed. Ast, 1819, i, 572; Zeller, (1), I, ii[6], 1230.
[6] VS, ii, 27: from an Arabic tr. of Galen.
[7] Zeller, (1), I, ii[6], 1244 f.
[8] VS, ii, 44; Aristotle, *De gen. animal.*, iii, 2, 752*b*, quotes this on the authority of Alkmëon of Kroton (p. 27) and, *ib.*, iii, 1, 751*b*, says it is the yolk which nourishes the embryo; actually both white and yolk do.
[9] VS, ii, 30–1.

'apart' and a creator. Creation is not due to seeds falling from heaven but to heat and 'innate life', living things coming from heated slime (as in the Egyptian theory reported by Diodoros Siculus, i, 7–8).[1]

Kleidemos (5 cent. B.C.) thought plants are made of the same substance as animals but are colder and 'more turbid' (θολερωτέρων). Cold things sprout in winter, hot in summer. Plant diseases (blight, etc.) are due to excess of water.[2] Idaios of Himera in Sicily (? fl. 450 B.C.) is said to have taken air as the primary substance, but Diels[3] attributes to him a theory mentioned several times by Aristotle that the primary substance is between air and water, or fire and air, in density, and things are formed from it by rarefaction and condensation.[4]

Diogenes of Apollonia

Diogenes of Apollonia (perhaps the one on the Black Sea, a colony of Miletos, less probably that in Crete) (*c.* 450–400 B.C.) was one of the last Ionian philosophers. His work *On Natural Science* (περὶ φύσεως) was known to Simplikios; he wrote also on meteorology. He identified νοῦς with air (ἀήρ), from which all things are formed and to which they return; it undergoes transformations by becoming warmer and colder, drier and moister, more stable and in swift motion. The soul of all living things is air, warmer than that outside but colder than that near the sun. There is only *one* substrate; air is essential to life, and is most easily able to change its character (hot, cold, moist, dry, and different in taste and colour (?)). It is mixed with intelligence, 'in short, Air is God.' It is boundless, everlasting, and imperishable, change is due to motion, which produces changes of density. According to Windelband, Diogenes identified air with pneuma (πνεῦμα), which mixes with the blood to form the essence of the soul, and hence, as he recognised the difference between venous and arterial blood, he 'meant by his πνεῦμα what the chemistry of to-day calls oxygen'. Rohde says he identified the upper air with ether (αἰθήρ) and Zeus.

As proof of the unity of substance Diogenes refers to the assimilation of materials from the earth by plants, and of plants by animals, and he was interested in physiology. The Hippokratic books on the heart (περὶ καρδίης) and on breaths (περὶ φυσῶν) are said to show his influence. An influence on Demokritos was assumed by Tasch. His system contains incompatible elements from Anaximenes and Anaxagoras.

The sea is salt because the sun draws up the 'sweet [water]' and the residue is salty. Plants are generated when water putrefies and takes up air; they have no intelligence. The opposite element to air is Fluid (ἰκμάς, *ikmas*), which is denser; animals breathe it in and get it from wetter food. Fish live because there is air in water, but they die in air because there is too much of it. Air is responsible for sense-perceptions, due to an inner air, reached by the outer air in different amounts. The sperm is air-like (πνευματῶδες) and frothy.[5]

[1] Burnet, (1), 358; Freeman, (1), 1949, 275; Robin, 131; Ueberweg, (1), i, 103; VS, ii, 44; Zeller, (1), I, ii[6], 1270.

[2] Freeman, (1), 1949, 278; VS, ii, 50 (from Theophrastos).

[3] VS, ii, 51.

[4] Nikolaos of Damascus, probably incorrectly, attributed this to Diogenes of Apollonia; Zeller, (1), I, i[7], 341.

[5] Adam, 266; Baeumker, 17; Burnet, (1), 352; Deussen, (1), II, i, 50, 147; Freeman, (1), 1949, 279; (2), 87; Greenhill, in DBM, i, 1024; Rhousopoulos, in Diergart, (1), 174; Rohde, (1), i, 259 f., 321; Tasch, *Isis*, 1949, xl, 11; Ueberweg, (1), i, 50, 52; VS, ii, 51, 59, 61; Windelband, (1), 62; Zeller, (1), I, i[7], 338, 350, 353.

Early Greek Medicine

The practice of medicine probably had its origin in Greece, as elsewhere, in magic and religion,[1] but the temples of Asklepios were nursing homes.[2] In Egypt, Imhotep, the vizier of King Zoser (III dyn., *c.* 2800 B.C.), later (*c.* 525 B.C.) became a god of medicine, called in Greek Imouthes or Imouth,[3] perhaps identified with Asklepios (who may be of Babylonian origin).[4] Celsus[5] says medicine was at first part of philosophy; Pliny[6] names Orpheus, Pythagoras, Demokritos (who visited Persia, Egypt, etc.) and Ostanes (a great Persian magician) as physicians. Some Babylonian and Egyptian medicine probably reached Greece, partly through Persia, and influence from India is possible.[7]

Greek medical schools were active from the 6 cent. B.C. and important from *c.* 450 B.C. at Kos, traditionally under Hippokrates, and Knidos under Euryphon, his contemporary.[8] In S. Italy at Kroton Alkmeon (Ἀλκμεων, formerly read Alkmaion), *c.* 510–480 (or fl. 450) B.C., introduced under Pythagorean influence the idea of the 'opposites' into medicine, and probably supplied material for some works attributed to Hippokrates. Health results from a correct mixture (*ἰσονομία*) or temperament (*κρᾶσις*, *krasis*) of hot and cold, and moist and dry; disease is caused by an excess (*μοναρχία*) of one of these, or to some external cause such as deficiency of food, certain kinds of waters, the site of the dwelling, etc. The soul is located in the brain, sensation passing to it through canals, and it is in eternal motion, like the stars. It is a 'harmony', because it holds together the opposites in the body.[9]

Wellmann[10] supposed that the Sicilian School taught that the soul or vital pneuma (*ψυχικὸν πνεῦμα; δύναμις ψυχικῇ*) is in the heart, whilst the School of Kos located it in the brain. It circulates in the veins and arteries, said to have been distinguished by Euryphon. It is not certain that Alkmeon was a Pythagorean. He did valuable research on the nature of sense-perception (used by Empedokles and Demokritos), generalised on the nature of health, and speculated on natural phenomena. He attracted the attention of Plato.

HIPPOKRATES

The seventy or so treatises attributed to Hippokrates are of various dates and authorship. They often contradict one another and probably none is by

[1] Partington, (1), 177, 310.

[2] A. B. Cook, ii, 1085; Daremberg, (1), i, 79; J. S. Elliott, (1), 18; Fuchs, in Puschmann, (1), i, 191; Haeser, (1), 62; W. H. S. Jones, (1), 158; M. Neuburger, i, 93; Rohde, (1), i, 141; Sprengel, (1), i, 140; Withington, *Isis*, 1922, iv, 429.

[3] J. B. Hurry, *Imhotep, the Vizier and Physician of King Zoser and afterwards the Egyptian God of Medicine*, Oxford, 1926; Sethe, *Imhotep*, Leipzig, 1902; Zosimos, in Berthelot, (1), 9, 184.

[4] Budge, (3), 17, 28; Prinz, PW, vii, 1908.

[5] *De Medic.*, i, proem.

[6] xxv, 2; xxvi, 1; xxix, 1; xxx, 1, 2.

[7] Budge, (3), 55–8; Filliozat, (1), 161 f., 197.

[8] Greenwood, DBM, ii, 112.

[9] Burnet, (1), 193, 295; Cornford, CAH, iv, 548; Goebel, 175; Gomperz, (2), i, 148; Heidel, *Amer. J. Philol.*, 1940, lxi, 1 (3); Senn, *A. Med.*, 1930, xxiii, 285; Ueberweg, (1), i, 72; VS, i, 210, 495; Wellmann, *Archeion*, 1929, xi, 156; *A. Med.*, 1930, xxiii, 291; Zeller, (1), I, i[7], 436, 596.

[10] (1), 20, 77, 96, 103: Akron, 108; Philistion of Lokroi, 109; Diokles, 117; Vindicianus, 208.

Hippokrates, who may have been a real person. The oldest (*c.* 450–350 B.C.) show the influence of the school of Kroton and the humoral pathology of Alkmeon. The writings were brought to Alexandria in the 3 cent. B.C. and edited about 200 B.C.[1]

Plato[2] quotes from Hippokrates that it is necessary to examine the nature (φύσις) and active quality (δύναμις) of compound things, and *Anonymus Londinensis* (see p. 186) says that winds (φῦσαι) cause diseases.[3] These may be doctrines of the historical Hippokrates. Syriac and Arabic authors (e.g. Thābit ibn Qurrah, d. A.D. 901) call him Buqrāṭīs, and wrote commentaries on his works.[4] In alchemical works[5] he seems to have been confused with Demokritos. The Dogmatic (or Rationalist) School of medicine, said to have been founded by Thessalos of Kos (fl. *c.* 420 B.C.), one of two sons of Hippokrates, continued his traditions.[6]

The work *On Ancient Medicine* (περὶ ἀρχαίης ἰατρικῆς) (430–420 B.C. ?) attacks the influence of philosophy in medicine, particularly the views of Empedokles; it rejects the 'new' theory of opposites, and reverts to the theories of Alkmeon.[7] Great stress is laid on 'coction' or 'concoction' (πέψις, *pepsis*), produced by heat in the body and usually resulting in a thickening of the body fluids. It brings the different opposing humours into an equilibrium in health. In disease, coction was either restored on a 'critical' day, or it was not and the patient died.[8] The materials of disease pass through three stages of healing: (1) rawness (ἀπεψία), (2) coction (πέψις), and (3) crisis (κρίσις) or separation.[9]

The old *Airs, Waters, and Places* (περὶ ἀέρων ὑδάτων τόπων)[10] relates the potability of waters to imaginary differences of density, no method of measuring which is given. Melted snow or ice is unhealthy because the cold has dried

[1] *Opera:* (1), ed. A. Foes, f°, Frankfurt, 1621; ed. J. A. Vander Linden, 2 vols., Leyden, 1665; ed. C. J. Kühn, 3 vols., Leipzig, 1825–6–7 (in *Medicorum Graecorum Opera*, vols. xxi–xxiii); ed. E. Littré, 10 vols., Paris, 1839–61 (Greek and French, standard ed., excellent index); R. Fuchs, *Sämtliche Werke ins deutsch übersetzt und ausführlich commentiert*, 3 vols., Munich, 1895–7–1900. Partial eds.: ed. Kuehlwein, Teubner, 2 vols., 1894, 1902; with trs., F. Adams, *The Genuine Works of Hippocrates*, 2 vols. 1849; J. Chadwick and W. N. Mann, *The Medical Works of Hippocrates*, Oxford, 1950; *Works*, ed. and tr. W. H. S. Jones, Loeb ed., 4 vols., 1923 (i, ii), 1927 (iii), 1931 (iv), with valuable essays and notes. Contents of Littré's ed., Guinet, *Isis*, 1926, viii, 87; A. Foes, *Oeconomia Hippocratis alphabeti serie distincta*, f°, Frankfurt, 1588; Wellmann, Hippokrates Glossare, in QS, 1931, ii (88 pp.): in refs. the eds. are denoted by Foes (Fo), Fuchs (Fu), Jones (J), Kühn (K), Littré (L), Vander Linden (V). On Hippocrates see J. C. G. Ackermann, *Institutiones Historiae Medicinae*, Nürnberg, 1792 (BM 550. a. 22); *id.*, in Fabricius, (1) (*b*), 1791, ii, 506–611; Daremberg, (1), i, 89; Diels, (3), 24; Edelstein, PW, 1934, Suppl. vi, 1290; R. Fuchs, in Puschmann, (1), i, 153, 170, 196–268; Gossen, PW, viii, 1801; Greenhill, DBM, ii, 481; Haeser, (1), i, 109; W. H. S. Jones, *Proc. Brit. Acad.*, 1945, xxxi, 103; *id.*, intr. to Loeb ed. of Hippokrates, 1923, i; *id.*, *Anonymus Londinensis*, Cambridge, 1947, 9, 19–20, 157; *id.*, in Singer, (4), i, 100; Meyer-Steineg and Sudhoff, 54; M. Neuburger, (1), i, 101, 112; Pfaff, *Isis*, 1934, xxi, 348; Sprengel, in Ersch-Gruber, 1831, II, viii, 339; Wellmann, *Archeion*, 1929, xi, 157; *id.*, *A. Med.*, 1930, xxiii, 299.

[2] *Phaidros*, 270c.

[3] W. H. S. Jones, (1), 9, 20, 34–42.

[4] Flügel, in Ersch-Gruber, 1831, viii, 344.

[5] Berthelot, (3), 217; (4), i, 301; ii, 37.

[6] Dilber, PW, II Reihe, vi, 165.

[7] Ch. xiii f.; J, i, 35; text, tr., and notes, W. H. S. Jones, *Bull. Soc. Hist. Med.*, 1946, Suppl. viii (100 pp.); A. J. Festugière, *L'Ancienne Médicine*, 1948; Scoon, 278.

[8] Chs. xviii–xix.

[9] Haeser, (1), i, 148.

[10] J, i, 65; K, i, 534; L, ii, 12; Brock, (1), 53; Burckhardt, in Diergart, (1), 73; Hoefer, (1), i, 80; A. Ruest, *Monographie der Sprache d s hippokratischen Traktates περὶ ἀέρων ὑδάτων τόπων*, Freiburg (Schweiz), 1952.

up the finer parts of the water. This may be shown by freezing a measured volume of water in an open vessel and re-melting, when a smaller volume of water is recovered (an inaccurate quantitative experiment). Some waters are marshy and soft (μαλακός), others from stony places are hard (σκληρός), others brackish. Rain water is lightest and finest, for the sun draws up the lightest part, as is proved by salt deposits, the coarse saline part being left behind; the sun also attracts moisture from the sea. Rain water soon putrefies and should be boiled to prevent this. Bad waters are those from stagnant ponds or marshes, hard waters come from rocks, and those waters coming from the earth when they are warm or where there is iron, copper, gold, silver, sulphur, soda (νίτρον), alum (στυπτηρία), or bitumen (ἄσφαλτος), formed by the action of heat (ὑπὸ βίης γίγνονται τοῦ θερμοῦ) are perhaps the earliest reference to the supposed constituents of mineral waters. Mist on falling mixes with water (ἐγκαταμιγνεύμενος) and clouds its transparency. Waters forming deposits of mud and sand in vessels are bad. Those who think saline waters (ἁλμυρὰ ὕδατα) are purging are wrong; they contract the bowels and cause constipation. Rain is caused by condensation of water vapour in clouds by the shock of winds.

The work *On the Nature of Man* (περὶ φύσεως ἀνθρώπου), attributed to Hippokrates' son-in-law Polybos (*c.* 300 B.C. ?), contains the theories of opposites, the four elements, and the four humours, rejected in the *Ancient Medicine*.[1] It opposes the view that the body is formed of only one principle and supports Empedokles' theory of the four elements. It first introduces the theory of what were later called the *four humours*: blood, phlegm, yellow bile, and black bile, constituting the human body (αἷμα καὶ φλέγμα καὶ χολὴν ξανθήν τε καὶ μέλαιναν, καὶ ταῦτά ἐστιν αὐτέῳ ἡ φύσις τοῦ σωμάτος).[2] Their properties correspond with those of the four elements and four seasons: blood, moist and warm, spring; phlegm, moist and very cold, winter; yellow bile, dry and warm, summer; black bile, dry and cold, autumn. Each season has a characteristic disease. Galen[3] wrote a commentary on the work; he attributed the theory of the four elements to Hippokrates and its development to Aristotle.[4] The name χύμος (*chymos*) is sometimes used for a humour or animal juice.[5] In health the four humours are in a state of proper mixture (κρᾶσις, *krasis*; later called εὐκρασία, *eukrasia*), force, and quantity. Disease is caused by an excess or defect of a humour (δυσκρασία, *dyskrasia*) and is treated by medicines having opposite qualities. This so-called 'humoral pathology', an extension of early philosophical theories, was a medical dogma for centuries.[6]

Philolaos (see p. 13) had three humours, blood, bile, and phlegm.[7] Praxagoras of Kos (*c.* 325 B.C.) recognised ten humours (not counting blood which made eleven), which were subdivisions of the four, and gave a demonstration proper to each.[8] Diokles of Karistos, dated 400–350 B.C. by Wellman

[1] L., vi, 32; Gilbert, 350; Gossen, PW, viii, 1801 (1820); Singer, (1), 97; A. E. Taylor, 588.
[2] L., vi, 38.
[3] Ed. Kühn, xv, 1.
[4] *Ib.*, x, 16; xv, 49.
[5] Fo, 15; Diels, (3), 124.
[6] L, vi, 40, 52, 92; Haeser, (1), i, 160.
[7] Gilbert, 352.
[8] Galen, ed. Kühn, ii, 141; E. D. Baumann, *Janus*, 1937, xli, 167.

but (since he is first mentioned by Theophrastos,[1] *c.* 300 B.C. by Jaeger,[2] admitted two humours: phlegm from excess of cold and bile from excess of heat (Edelstein said he recognised both red and black bile). He taught that *pneuma* (πνεῦμα) is the natural heat of the body (ἔμφυτον θερμόν)[3] and that digestion is a kind of putrefaction.[4] He is said to have written on botanical superstition and poisons.[5]

The number seven occurs frequently in the Hippokratic Collection, e.g. in connection with the 'critical days', perhaps under Pythagorean influence.[6] The treatise on the number seven (περὶ ἑβδομάδων), which has been much discussed,[7] is of uncertain date (5–4 cent. B.C., or *c.* A.D. 100). It mentions the theory of the macrocosm (μέγας κόσμος) and microcosm (μικρὸς κόσμος), i.e. that there is a relation between the universe or 'cosmic man' and man, who is a 'small world'. This was known to Demokritos. The theory has been regarded as Iranian,[8] Babylonian,[9] Orphic[10] or Jewish.[11] It appeared in China[12] and may have arisen independently in various places in ancient times.[13]

The work *On Nutriment* (περὶ τροφῆς) (*c.* 400 B.C.) is based on Herakleitos's idea (see p. 8) of constant change. Fire, itself 'one', when dissolved in moisture is carried to all parts of the body, and in contact with them becomes bone, flesh, fat, etc. Air is also food, passing from the arteries to the heart. What is 'left over (πλεονασμός)' when nourishment has taken place is blood or milk. A food good for one is bad for another.[14]

The work *On Regimen* (περὶ διαίτης) (*c.* 370 B.C. ?)[15] extends the idea of the formation of the body from fire and water and explains the effects of heat in nutrition (formation of flesh, bone, etc.), the different kinds of food for females (cold and moist) and males (warm and dry), the influence of foods on the birth of a boy or girl, etc. 'The moistest fire and the driest water when blended in a body produce the greatest intelligence', since each is supplemented and made self-sufficient.[16] Fire moves, water nourishes (*πῦρ δύναται πάντα διὰ παντὸς κινῆσαι, τὸ δὲ ὕδωρ πάντα διὰ παντὸς θρέψαι*).[17] All things, divine and human, alternate between the above and the below (ἄνω καὶ κάτω)

[1] *On Stones*, § 28; *Opera*, Paris, 1866, 344.

[2] Gilbert, 344; Greenhill, DBM, i, 1011; Jaeger, (1), 11, 55, 70, 109, 113, 156, 181, 212, 220 (crit. by Edelstein, *Amer. J. Philol.*, 1940, lxi, 483); Meyer-Steineg and Sudhoff, 72; Wellmann, PW, v, 802; *id.*, (1), 65, 67.

[3] Gilbert, 348; Haeser, (1), i, 138; Ross, (3), 56.

[4] Wellmann, (1), 125.

[5] Jaeger, (1), 164; Wellmann, (1), 191.

[6] Fu, i, 79, 90, 164, 249, 259, 436, etc.; L, x, 790 (index); Sticker, *A. Med.*, 1929, xxii, 333; Sudhoff, *ib.*, 1929, xxi, 1.

[7] L, viii, 616; Boll, (3); *N. Jzhrb. klass. Alt.*, 1913, xxxi, 89 (137); Roscher, *Abhl. Sachs. Ges., phil.-hist. Kl.*, 1906, xxiv, no. 1; 1911, xxviii, no. 5; Sudhoff, MGM, 1919, xviii, 326; Wellmann, (1), 43; QS, 1933, iv, 6.

[8] Eisler, (1), 738; Goetze, *Z. Indol. Iran.*, 1923, ii, 60–98 (82), 167; Reitzenstein, (7), 7, 61 f., 70 f., 114, 118, 130, 147.

[9] Boll, (3), 23, 97; Bouché Leclercq, 545, 571; Jeremias, 180; Meissner, ii, 107, 110, 130, 267, 293.

[10] Festugière, (1), i, 92; Lobeck, ii, 908–47.

[11] W. Scott, (1), ii, 5–21, 60, 110.

[12] Needham, (1), ii, 294.

[13] A. Meyer, Wesen und Geschichte der Theorie vom Mikro- und Makrokosmos, *Berner Studien zur Philosophie und ihrer Geschichte*, Berne, 1900, xxv, 1–122.

[14] J, i, 337 f.; §§ xxxiii, xxxvi, xliv.

[15] Jaeger, (1), 170, early 5 cent. B.C.; Ross, (3), 56 (*c.* 370 B.C.).

[16] *Reg.*, I, vii, ix, xxvii, xxxv; J, iv, 224–447.

[17] *Reg.*, I, iii; L, vi, 472.

by divine necessity (δἰ ἀνάγκη θείην).[1] Like joins to like (προσίζει τὸ σύμφορον τῷ συμφόρῳ) but unlikes struggle (πολεμεῖ) and separate (διαλλάσσει ἀπ' ἀλλήλων).[2]

The work *On the Heart* (περὶ καρδίης) (*c.* 370 B.C. ?), perhaps by Philistion of Lokroi, says blood is cold by nature and is warmed by the body. Galen quotes it for the idea (given by Plato) that part of a liquid drunk passes to the lungs.[3]

The work *On Diet* (περὶ διαίτης) may be as old as Herakleitos (500 B.C.) and incorporates the idea that 'the way up and down is one (ὁδὸς ἄνω κάτω μία)'; it may be connected with Alkmeon.[4]

The treatise *On Winds* (or *Breaths*) (περὶ φυσῶν, *de flatibus*), attributed to Diogenes of Apollonia (see p. 26), according to Jones is by a Sophist at the end of the 5 cent. B.C.[5] The distinction between outer air (ἀήρ) and inner breath (πνεῦμα)[6] is early Indian.[7] The work speaks of air (ἀήρ), wind (ἄνεμος), and pneuma (πνεῦμα) without clearly distinguishing them.[8] Air is conveyed by the veins and is essential to life; it is in the sea (τὸ πέλαγος μετέχει πνεύματος) and is necessary for the life of fish; it is also the principle of fire and hence is in the sun and moon. Air (πνεῦμα) is the food of fire and fire deprived of air cannot live (τῷ γὰρ πυρὶ τὸ πνεῦμα τροφή. τοῦ δε πνεύματος τὸ πῦρ στερηθὲν οὐκ ἄν δύναιτο ζῆν).[9] Air is the cause of diseases.[10] Galen[11] says Hippokrates purified the air in an epidemic of plague by burning fires and fumigating with odours and unguents, and supposed that the 'divine' participant in diseases is an effect of the air.[12] Air is between the upper ether (αἰθήρ) and the earth.[13] The finest part (πνεῦμα) of the air (ἀήρ) passes through the nose and mouth to the brain; another, considerable, part passes to the belly (κοιλία), and the rest goes to the lungs, from which it passes through the veins (φλέβες) to the heart.[14]

The Hippokratic collection names 236 plant drugs; Dioskourides has about 500 and Pliny 1000. Mineral drugs, partly native and partly products of smelting, are used almost exclusively for external application or in diseases of women. Very few drugs are named in the works attributed to the school of Kos, many more in those attributed to that of Knidos. The latter include several Egyptian (white oil, ointments, alum, salt, soda, saffron ?), Indian

[1] *Reg.*, i, 5; L, vi, 476–8; Fu, i, 284, 291.

[2] *Reg.*, i, 6; L, vi, 480; *De morbis*, iv, 7; V, ii, 125; L, vii, 550: ὅμοιον ἔρχεται πρὸς τὸ ὅμοιον.

[3] F. C. Unger, *Mnemosyne*, 1923, li, 1–101 (text 51–7); Gossen, PW, viii, 1837; Ross, (3), 325, 337; Wellmann, (1), 98 f.

[4] Text in Diels, (6); Burnet, (1), 150; Ueberweg, (1), i, 60; Wellmann, *A. Med.*, 1929, xxii, 291; Zeller, (1), I, i[7], 870 (*c.* 420–380 B.C.).

[5] J, ii, 219–53; L, vi, 90–115; Gossen, PW, viii, 1801 (1816); Wellmann, *Hermes*, 1926, lxi, 329.

[6] K, i, 571; L, vi, 94.

[7] Filliozat, (1), 184 f.

[8] Haeser, (1), i, 131; W. H. S. Jones, (1), 10; Peck, in Singer, (4), i, 113; Singer, (1), 66, 87; (2), 8; *id.*, in OCD, 48.

[9] *De flat.*, § 3; K, i, 571; L, vi, 94.

[10] L, vi, 96.

[11] Kühn, xiv, 281.

[12] *Ib.*, XVIII, ii, 17, 21.

[13] περὶ σαρκῶν, § 2; K, i, 425; L, viii, 384 (later than Aristotle: Diels, (2), 17; Zeller, II, ii, 441).

[14] *De morbo sacro*, § 7; J, ii, 127 f.; K, i, 599; L, vi, 372.

(*Sesamum orientale*, cardamom, *Andropogon*, *Amomum*; white, black, and long pepper, squill (σκίλλη), etc.), Babylonian and Persian (*oleum Susinum*, ammoniac gum (ἀμμονιακόν), and galbanum). Surgical instruments, derived from Egypt, include lancets and cupping glasses.[1] The mineral drugs and many prescriptions resemble those in the Egyptian *Ebers Papyrus* (*c.* 1570 B.C.).[2] Weights and measures are sometimes specified, but no details of pharmaceutical manipulation are given in the prescriptions. The following treatises are quoted below:

(1) περὶ ἀέρων, ὑδάτων, τόπων (*de aëre, aquis, et locis*).
(2) περὶ φυσῶν (*de flatibus*).
(3) περὶ ἐπικυήσιος (*de superfœtatione*).
(4) περὶ διαίτης (*de diaeta*).
(5) περὶ τόπων τῶν κατ' ἄνθρωπον (*de locis in homine*).
(6) περὶ νούσων (*de morbis*).
(7) περὶ τῶν ἐντος παθῶν (*de internis affectiontionibus*).
(8) περὶ γυναικείης φύσιος (*de natura muliebri*).
(9) περὶ γυναικείων (*de mulierum morbis*).
(10) περὶ ἀφόρων (*de sterilibus*).
(11) περὶ ἑλκῶν (*de ulceribus*).
(12) περὶ συρίγγων (*de fistulis*).
(13) περὶ ἱρῆς νούσου (*de morbo sacro*).
(14) περὶ γονῆς (*de genitura*).
(15) περὶ αἱμορροΐδων (*de haemorrhoidibus*).
(16) 'Επιδημίων (*epidemiorum*).

The metals are gold, silver, copper, tin, lead, and iron; mercury and its compounds are not mentioned. Those who work gold heat it, wash it, and melt it in a gentle fire; in a violent fire gold does not join together:[3] κρυσίον ἐργάζονται, κόπτουσι, πλύνουσι, τήκουσι πυρί μαλακῷ, ἰσχυρῷ δὲ οὐ συνίσταται.

Red copper is the ordinary metal.[4] White copper (χαλκός λευκός)[5] is perhaps brass. The softest and least compact copper is susceptible of the largest mixture (πλείστην κρῆσιν).[6] Copper filings were used externally;[7] flower of copper (ἄνθος χαλκοῦ),[8] copper scales,[9] calcined copper,[10] and copper burnt till red,[11] are all forms of oxides; the ἀφρός χαλκου[12] is perhaps verdigris, otherwise called ἰός.[13] *Chalkitis* (χαλκῖτις)[14] is blue vitriol; *chrysokolla* (χρυσόκολλα)[15] is probably malachite.

Flower of silver (ἄνθος ἀργυρέω)[16] and *molybdena* (μολύβδαινα)[17] are probably litharge (lead oxide), but *miltos* (μίλτος) is probably red ochre, not

[1] Filliozat, (1), 211; Haeser, (1), 164; Schelenz, (1), 51, 64, 98, 104; A. Schmidt, 7, 10, 17; Singer, (2), 7 f., 13 f., 17, 20.
[2] Partington, (1), 185; Singer, (1), 83.
[3] (4), i, 20; L, vi, 494.
[4] (11), 12, 17; (9), i, 104; L, vi, 412, 420; viii, 226.
[5] (10), 222; L, vi, 430.
[6] (4), i, 32; L, vi, 506.
[7] (9), i, 78; L, viii, 186.
[8] (6), (8), (9), (10), (11), (12); see L, index, x, 551.
[9] (11), 13, 16; (9), i, 96; L, vi, 417, 420; viii, 225.
[10] (9), i, 74; L, viii, 160.
[11] (9), i, 95; L, viii, 222.
[12] (9), i, 104; L, viii, 226.
[13] (11), 14, 21; (15), 8; (9), i, 75, 78, 102; (10), 223; L, vi, 416, 442; viii, 166, 186, 224, 433.
[14] (11), 13, 14, 21 (blue); (15), 7 (calcined); (12), 9; (9), i, 104; Fu, ii, 186; iii, 59, 291, 297, 488, 495; Celsus, *De med.*, v, 1, 6, 9, 28; vi, 11.
[15] (12), 7; (19), i, 63; Fu, iii, 311, 347; L, vi, 454; viii, 130; Celsus, v, 6, 8.
[16] (11), 14; (6), ii, 13–14; (8), 33; (9), i, 57, 90; ii, 121; L, vi, 416; vii, 24, 26; viii, 116, 218, 264; Fu, iii, 291.
[17] (11), 14, 21; (15), 8; (12), 10; (9), ii, 188; L, vi, 416 424, 426, 442; vi, 442, 461; viii, 368.

red lead.[1] Golden ash (χρυσίτης σποδός)[2] is perhaps massicot (lead oxide); white lead is *psimuthion* (ψιμύθιον);[3] lead burnt with much sulphur (μόλιβδος κεκαυμένος σὺν πολλῷ θείῳ) is perhaps lead sulphide;[4] 'washed lead' (μόλιδος τὸν λεῖον)[5] may be hydroxide formed on standing in water. A probe of tin (κασσίτερος) is mentioned.[6]

Spodos (σποδός), including Cyprian and Illyrian,[7] is impure zinc oxide. *Tetragonon* (τετράγωνον)[8] is said by Galen to be στίβι (antimony sulphide). *Misy* (μίσυ)[9] is impure ferrous sulphate. The Magnesian stone (Μαγνησίη λίθος)[10] is a purgative and is probably magnesia. Alum (στυπτηρία) is often mentioned, including Egyptian, Melian, schistous (σχιστῆς), and calcined.[11] Salt (ἅλς), including Theban and Egyptian,[12] and soda (νίτρον, λίτρον), including solution, toasted, Egyptian[13] and red Egyptian[14] are often mentioned, also *aphronitron* (see p. 103).[15] Burnt wine lees[16] is potash. Sulphur (θεῖον; θ. ἄπυρον) is often mentioned, sometimes (with bitumen, ἄσφαλτος, or horn) for fumigation, or for external application.[17] Red and yellow arsenic sulphides, realgar (σανδαρακή) and orpiment (ἀρρενικόν),[18] are used, sometimes for fumigation.

Organic materials include white vinegar 'as strong as possible'.[19] The root of mandrake (*Atropa mandragora*, *Mandragora officinalis*, containing atropine and hyoscyamine), used as a narcotic, is said to be dangerously poisonous.[20] Manna (μαννα) is incense (e.g. galbanum resin).[21] Cantharides are often mentioned.[22]

The quenching of a heated black stone (flint ?) in wine,[23] and of iron (steel) in oil,[24] are mentioned. A water bath in the form of a pot immersed in another pot of hot water is specified.[25] A tube luted to a cover of a pot so that steam can issue from the tube,[26] was described in the Egyptian Ebers Papyrus (*c.* 1570

[1] (11), 22; (12), 9; L, vi, 426, 458.
[2] (9), i, 103; L, viii, 226.
[3] (11), 21; (6), ii, 14; (8), 29; (9), i, 66, 103; L, vi, 424; vii, 26, 344; viii, 140, 227.
[4] (11), 16; Fu, iii, 293; L, vi, 418.
[5] (11), 13; L, vi, 416.
[6] (12), 4; (6), ii, 33, 35, 47, 59; (9), i, 60; (10), 230; L, vi, 450; vii, 50, 52, 70, 92; viii, 122, 444.
[7] (11), 13, 21, 23; (9), i, 37, 103–4; L, vi, 416, 426, 428; viii, 92, 226.
[8] (7), 45, 49; Fu, ii, 536, 541; L, vii, 278, 290; Nies, PW, i, 2437.
[9] (11), 17; (8), 32, 98; (9), i, 76, 78, 103; L, vi, 422; vii, 354, 362, 414; viii, 170, 174, 224.
[10] (7), 21; L, vii, 218.
[11] (16), v, 69; vi, 5; vii, 66; (5), 47; (11), 11–18; (15), 8; (12), 3; (19), i, 63; etc.; L, v, 244, 308, 430; vi, 346, 412–22, 442, 450; viii, 130; etc.
[12] (8), 72; (9), i, 75; ii, 164; L, vii, 404; viii, 168, 344.
[13] (11), 12–18; (12), 6; (6), ii, 13, 28; iii, 16; (7), 26, 31; (10), iii, 235; L, vi, 412–16, 422, 452, vii, 46, 150, 236, 249; viii, 450; etc.
[14] (16), v, 69; vi, 5; vii, 66; (12), 10; (7), 51; (8), 32; (9), ii, 206; vi, 460; vii, 294, 362; viii, 400.
[15] (9), i, 75; L, viii, 164.
[16] (6), ii, 13; L, vii, 24.
[17] (6), iii, 10; (8), 26; (9), ii, 114, 191; L, vii, 130, 342; viii, 246, 370.
[18] (11), 16, 17; (6), ii, 14; (9), i, 78, 100; ii, 203; L, vi, 420; vii, 26; viii, 196, 224, 388; Fu, ii, 416; iii, 293, 480, 492, 494.
[19] (11), 12, 14; L, vi, 414, 416.
[20] (5), 39; (9), i, 74; L, vi, 328; viii, 160; Lippmann, (1), i, 190.
[21] (8), 34, 103; (9), i, 78; ii, 195; L, vii, 372, 418; viii, 190, 378; Fu, ii, 168, 294, 318; iii, 464.
[22] L, index, x, 509.
[23] (10); L, viii, 430; Fu, iii, 603.
[24] (6), iii, 16; L, vii, 146.
[25] (6); iii, 17; L, vii, 156.
[26] (5), 47; (6), ii, 26; L, vi, 346; vii, 40; Fu, ii, 481; iii, 528, 608.

B.C.).[1] There is no mention of distillation but it is said that when wine is thrown on an altar fire a flame [of alcohol] leaps up but at once dies down.[2] This was later said to have occurred as a prodigy on the birth of the emperor Augustus.[3]

[1] Partington, (1), 185.
[2] (14), 4; L, vii, 476.
[3] Lippmann, (2), iii, 31.

CHAPTER II

THE EARLY GREEK ATOMIC THEORY

Leukippos

Leukippos, who is said to have been born at Miletos, Abdera (favoured by Diels), or Elea, is a very shadowy figure; Epikouros[1] doubted his existence. He was said to have been a pupil of Zeno or Melissos and the teacher of Demokritos. Since his theory is parodied by Aristophanes in 423 B.C. he must have flourished about 430 B.C., or somewhat earlier, perhaps as early as 450 B.C.[2] He is credited with a book, *The Great World Order* (*Μέγας Διάκοσμος*), from which Demokritos (who wrote a work of the same title) is said to have derived his basic doctrines. His views were also adopted by Diogenes of Apollonia (p. 26). Aristotle[3] says the Eleatic School (see p. 15) taught that the All is One and immovable, and that there is no motion; but 'to hold such a view seems like madness'. He goes on to state:

> 'Leukippos thought he had a theory consistent with sense perception which did not do away with coming into being and passing away, nor motion, nor the multiplicity of things. He agreed so far with the evidence of the senses, but he also agreed with those who put forward the theory of the One on the ground that there could be no motion without empty space, that empty space is not real, and that nothing of what is real is not real; for, he said, the real in the strict sense is an absolute *plenum*, but the *plenum* is not one, rather there is an infinite number of them, and they are invisible owing to the smallness of their bulk. These move in a vacuum (*κενός*), for there is a vacuum, and by their coming together they give rise to coming into being, and by their separation, passing away.'

This argument may be paraphrased as follows:[4]

I. *The Eleatic argument:*	II. *Leukippos's argument:*
Without a vacuum there is no motion.	Without a vacuum there is no motion.
There is no vacuum.	There is motion.
Therefore there is no motion.	Therefore there is a vacuum.

By introducing empty space as something existing and yet 'not real (*μὴ ὄν*)' in the sense that matter is real, Leukippos formed a new conception of

[1] In Diogenes Laertios, x, 13.
[2] Diogenes Laertios, ix, 30 f.; Baeumker, 79–95; C. Bailey, 1928, 66 (date); P. Bokownew, *Die Leukipp-Frage. Ein Beitrag zur Forschung nach der historischen Stellung der Atomistik*, 1911 (19 pp.); Burnet, (1), 1920, 330; Cornford, CAH, iv, 576; Deussen, (1), II, i, 135; Diels, Leukippos und Diogenes von Apollonia, *Rhein. Mus.*, 1887, xlii, 1; *id.*, VS, ii, 70; Freeman, (1), 1949, 285; (2), 90; Goebel, 257; Scoon, 1928, 196–229; Stenzel, PW, xii, 2266· Ueberweg, (1), i, 104; Zeller, (1), I, ii[6], 1038; *id.*, *Kleine Schriften*, 1910, ii, 185.
[3] *De gen. et corr.*, i, 8, 325*a*; *Metaphys.*, i, 4, 985*b*; VS, ii, 72; Zeller, (1), I, ii[6], 1047.
[4] Gomperz, (2), i, 347.

'reality'. Space is something non-corporeal, whose sole function is to be where the fuller reality is not, an existence in which the full reality, matter, can move and have its being. In this he was the first to see distinctly that a thing might be real without being a body. Space is empty (κενόν) or porous (μανόν), i.e. there are intervals (διαστήματα) between the particles of matter.[1]

Aristotle clearly says that Leukippos was the originator of the atomic theory, although he also says that Demokritos shared in its development. Diogenes Laertios[2] says 'Leukippos was the first to set up atoms as first principles (πρῶτός τε ἀτόμους ἀρχὰς ὑπεστήσατο) — which, with empty space, he calls elements (στοιχεῖα), (probably Aristotle's name). Aristotle's account of the origin of the atomic theory, as a criticism of the Eleatic theory, is probably correct.[3] Others[4] connect it with Anaxagoras (p. 22), whose views are really incompatible with atomism;[5] or with Empedokles,[6] or a continuation of Pythagorean number speculation.[7] The name 'atoms (ἄτομα)', nearly always plural, may go back to Leukippos.[8]

It is difficult to separate the parts of the theory due to Leukippos and Demokritos; Zeller does not attempt this, but Diels's arrangement is probably sound.[9] Aristotle, who probably had the separate works before him[10], and, Theophrastos[11] say that Leukippos taught that the atoms (σωμάτων; ἄτομα) are indivisible (ἀδιαίρετα), solid (στέρεα), full (πλήρη), compact or close-pressed (ναστά), and of all manner of shapes (παντοῖα τοῖς σχήμασιν). Leukippos (who often used quaint technical terms) says the atoms differ in three ways: in rhythm (ῥυσμός), touching (διαθιγή) and turning (τροπή), which Aristotle translated as shape (σχῆμα), arrangement (τάξις), and position (θέσις), respectively. Other technical names attributed to Leukippos are: great void (μέγα κενόν), absection (ἀποτομή), entanglement (περιπλέξις), and eddy (δῖνος).[12]

The atoms were at first assembled into an infinite mass, from which they separated off. They fall into space (εἰς τὸ κενόν ἐμπιπτόντων) and collect into a vortex (δίνη),[13] in which, by jostling, like atoms join with like. Since the atoms are 'so numerous that they can no longer revolve in equilibrium', the subtle ones pass out into space as if winnowed, whilst those remaining become entangled into a spherical shell, inside which are atoms of all kinds. This was the earth. Other similar bodies, being dried and ignited by the swiftness of motion, became the heavenly bodies. Demokritos seems to have called the

[1] C. Bailey, (1), 75–7.
[2] ix, 3–33; ed. Hicks, ii, 438 f.
[3] Burnet, (1), 334; Deussen, (1), II, i, 135; Gomperz, (2), i, 323, 345; Ueberweg, (1), 106; Zeller, (1), I, ii[6], 1175, 1181, 1257.
[4] Gilbert, 1907, 137 f., 152; see the discussion in C. Bailey, (1), 66 f., 106 f.
[5] Frank, 1923, 20, 48.
[6] E. V. Arnold, 1911, 41, 62; Kranz, *Hermes*, 1912, xlvii, 18.
[7] Cornford, (1), 1932, 8, 53, 57, 60, 241; CAH, iv, 576; Diogenes Laertios, ix, 44 (ὄγκοι); Gomperz, (2), i, 347 f.; Mabilleau, 107; A. E. Taylor, 508.
[8] Burnet, (1), 336 f.; Deussen, (1), II, i, 140 (sing. τὸ ἄτομον ?); Zeller, (1), I, ii[6], 1058.
[9] C. Bailey, (1), 69; A. Brieger; Burnet, (1), 336 f.
[10] *Metaphys.*, i, 4, 985*b*; Scoon, 199.
[11] In Diogenes Laertios, ix, 30–33.
[12] Mullach, 420 f.; VS, ii, 80.
[13] Why there is a vortex is not explained by Leukippos; C. Bailey, (1), 92 f.; Burnet, (1), 340 f.

original aggregate 'the all (τό πᾶν, *to pan*)'; Aristotle called it this, or ἄπειρον, or πανσπερμία.

Aristotle[1] says Leukippos and Demokritos taught that 'creation comes about by touching', the atoms coming into contact but never losing their identities, and there is always an interval of empty space between. Aristotle[2] quotes Leukippos and Demokritos as teaching that atoms 'are distinguished from one another by their figures, but their substance (φύσις) is one, like many pieces of gold separated from one another (τὴν δὲ φύσιν εἶναί φασιν αὐτῶν μίαν, ὥσπερ ἂν εἰ χρυσὸς ἕκαστον εἴη κεχωρισμένον)'. The differences in things are, therefore, caused by the differences in shape, position, and arrangement of the atoms, which account for 'opposites' (hot, cold, moist, dry) of which the so-called elements are aggregates (πανσπερμίαι).[3] Leukippos may have thought the atoms indivisible because they are so small, 'without parts (ἀμερῆ)',[4] not because they are infinitely hard, as Demokritos assumed.

The nature of the motion (κίνησις) of the atoms has been much discussed. Cicero[5] thought it was a 'random' motion or 'fortuitous concourse', but Aristotle merely says the atomists left it unexplained as 'spontaneous (αὐτόματον)'; for Demokritos this had the same meaning as τυχή, 'cause' rather than, as usual, 'chance'.[6] The only surviving fragment of Leukippos denies chance: 'Nothing happens for nothing but everything from ground and necessity (οὐδὲν χρῆμα μάτην γίγνεται, ἀλλὰ πάντα ἐκ λόγου τε καὶ ὑπ'ανάγκης).'[7] Demokritos used the word ἀνάγκη similarly, and sometimes λόγος. For Leukippos the atoms were separate from the beginning, and hence required no separation from aggregates (as with Anaxagoras and Empedokles).[8]

Zeller[9] thought the primary atomic motion was a perpendicular fall through space, as is said by Epikouros (p. 137), probably from some earlier authority, but[10] it was probably a confused, perhaps horizontal, motion in infinite space (which knows no up or down), or in a part (ἀποτομή) of empty space, 'this way and that'; a kind of Brownian movement, in which the atoms met 'accidentally' and so aggregated into things and worlds. The atoms from the beginning had a capacity for independent motion (κίνησις), not for qualitative change (ἀλλοίωσις). Zeller thought the heavy and light atoms fell with different speeds and so collided; they might then rebound, the lighter ones going up higher than the heavier.

[1] *De gen. et corr.*, i, 8, 325*b*; *De coelo*, iii, 4, 303*a*; the text gives περιπλέξις, 'entanglement' (by fitting together); περιπαλάξις, 'collision', is a mere conjecture of Diels, VS, ii, 80; C. Bailey, (1), 86 f.

[2] *De coelo*, i, 8, 275*b*–276*a*; iii, 5, 304*a*.

[3] Burnet, (1), 336–7; Gilbert, 148; Zeller, (1), I, ii[6], 1059 f.

[4] Aristotle, *Phys.*, vi, 1, 231*a*; C. Bailey, (1), 78, 284.

[5] *De nat. deor.*, i, 24, 66: ex his (atomi) effectum esse cœlum atque terram, nulla cogente natura, sed concursu quodam fortuito (Leukippos and Demokritos).

[6] C. Bailey, (1), 84; A. Brieger, (1), 13; *id.*, Die Urbewegung der Demokritischen Atome, *Philologus*, 1904, lxiii, 584–96; Hoefer, NBG, xiii, 370; Scoon, 203.

[7] Stobaios, *Eklog. Phys.*, i, 160, ed. Meineke, 1860, 42, quoting Leukippos' book περὶ νοῦ, which Diogenes Laertios, ix, 46, attributes to Demokritos; Freeman, (1), 1949, 289, thinks it is by some follower of Anaxagoras.

[8] Burnet, (1), 340 f.; Windelband, 43, 111.

[9] I, ii[6], 1076, 1093, 1098 (Nestle's note).

[10] Brieger, 1884, 4 f.; Burnet, (1), 341; Deussen, (1), II, i, 136, 141; Gilbert, 138; Scoon, 202; Windelband, 43.

The motion does not seem to have been conceived as a *single* vortex (δίνη); Diogenes Laertios[1] says the atoms, 'circling round in every possible way (παντοδαπῶς κυκλούμενα)', separate off, like joining with like, 'as if they were being winnowed (ὥσπερ διαττώμενα)', which seems to imply that light and heavy particles are separated, as in sifting grain. Hammer Jensen[2] regarded the passage, containing the word ἰσορρόπων, as referring to 'fine and other', not 'heavy and light' particles, but says it is corrupt. The translation 'all equal in weight' for ἰσορρόπων in Diogenes Laertios is doubtful; the old Latin translation[3] gives *aequilibria* (pl.), which is probably right,[4] in which case λεπτὰ following might mean 'light'. Burnet thought the 'heavy and light' property existed only in the vortex.

The atoms remaining entangled after the light ones have gone off into space form a spherical mass 'which parts off like a shell, enclosing within it atoms of all kinds'; by rotation this becomes thinner, producing what Lucretius called the 'flaming walls of the world (*flammantia moenia mundi*)',[5] but it can grow by influx of atoms from outside. Some of these are locked together in a damp, muddy mass, but when they have dried and revolve with the universal vortex, they take fire and form the substance of the stars.[6] The above seems to constitute the views expressed by Leukippos; their development is due to Demokritos.

Demokritos

Demokritos was probably born in Abdera in North Thrace about 460 B.C. or a little earlier and died there about 370 B.C.; he would be in his prime about 420 B.C., and he probably died very old (over 90 or even 100). Diogenes Laertios implies that he was younger than Anaxagoras (b. 498 B.C.). The problem that he was legendary for Herodotos, who died about 420 B.C., I leave the experts to resolve.[7]

The story that Xerxes (d. 465 B.C.) passed through Abdera on his way to and from Athens,[8] and[9] that he was entertained by the father of Demokritos and left Magians and Chaldæans to educate Demokritos (who was not then born)

[1] ix, 31. [2] *A. Phil.*, 1910, xxiii, 217 f., 221. [3] Cologne, 1542,551.
[4] Diogenes Laertios, tr. Hicks, ii, 444; Burnet, (1), 338, 344 (on ῥοπῇ).
[5] Lucretius, i, 73; Kroll, ERE, ii, 198. [6] Diogenes Laertios, ix, 32.
[7] Diogenes Laertios, ix, 34; Souidas, *s.v.* Δημόκριτος; (2), i, 1252; (3), ii, 44. V. E. Alfieri, *Gli atomisti frammenti e testimonianze* (*Collection Filosofi antichi e medievali*), Bari, 1936 (pp. xix, 410); C. Bailey, (1), 109 f.; S. Brown, *Lectures and Essays*, 1858, 81; Burnet, (1), 331; F. A. Cartheuser, *De Medicina Democriti Abderitae*, Giessen, 1775 (pp. 16); A. Dyroff, *Demokritstudien*. I *Zur Geschichte der ältesten Atomistik*. II *Zur Würdigung der demokritischen Philosophie*, Leipzig, 1899; Freeman, (1), 1949, 289–326; (2), 91–120 (fragments); Hoefer, NBG, 1855, xiii, 566; F. M. Jaeger, *Elementen en atomen eens en thans. Schetsen uit de ontwikkelingsgeschiedenis der elementenleer en atomistiek*, Groningen, 1918; W. Kahl, *Democritstudien*, Diedenhofen, 1889; Lange, 9, 62, 94 f.; Mabilleau, (1), 146 f.; J. Magnenus, *Democritus Revivescens sive De Atomis*, la. 8°, Papiæ, 1646, 1–27; A. O. Markovelsky, *Drevnegrecheskiye Atomisty* (Ancient Greek Atomists), Baku, 1946; K. Modritzki, *Die atomistische Philosophie des Demokritos in ihrem Zusammenhang mit früheren philosophischen Systemen. Programm des Stadtgymnasiums zu Stettin*, 1891 (pp. 8); P. Natorp, *Die Ethika des Demokritos*, Marburg, 1893; Partington, *Ann. Sci.*, 1939, iv, 245; Ritter, in Ersch-Gruber, 1833, XXIV, i, 35; G. O. Roch, *Die Schriften des Alexandrinischen Bischofs Dionysius des Grossen 'Über die Natur'. Eine altchristliche Widerlegung der Atomistik Demokrits und Epicurs*, Diss., Leipzig, 1882; M. Solovine, *Democrit. Doctrines philosophiques et réflexions morales*, 1928 (*Isis*, 1929, xiii, 143); Stahr, in DBM, i, 974; Ueberweg, (1), i, 105; VS, ii, 81–230; Wellmann, PW, ix, 135; Zeller, (1), I, ii[6], 1043.
[8] Herodotos, vii, 105, 109; viii, 120. [9] Diogenes Laertios, ix, 34.

in theology and astronomy, is improbable. Demokritos is said to have spent his share of 100 talents (£20,000) of the family property in travels to Egypt (where he spent five years), Persia (where he visited the Chaldæans), Asia, the Red Sea, Arabia, and even India and Ethiopia.[1] He returned to Abdera and lived in humble circumstances, but on reading his work *Great Diakosmos* (see below) he received a reward of 500 talents, bronze statues and a public funeral.[2] The tradition that he worked in tombs suggests the East.[3] His authorship of a dozen mathematical works[4] suggests that he may have visited Egypt.[5] C. Bailey[6] did not think it impossible that some knowledge of Indian atomism may have reached Demokritos (but not Leukippos) by way of Phoenicia, as the story of Mōchos probably suggests, or possibly through the Ionian colonies, as the story of the instruction of Demokritos by the wise men in Xerxes' army would imply. The story of his travels in the East perhaps originated in the first century B.C., when he was confused with Bolos of Mendes (see p. 211) and regarded as the originator of magic in Greece.[7] Philostratos[8] denied that Demokritos was a magician. Clement of Alexandria said he wrote a book on the religion of the Magi. In the Greek alchemical works, the teacher of Demokritos is Ostanes the Mede; this statement also appears in Tatian (A.D. 150) and Synkellos (*c.* A.D. 810).[9] Pliny[10] makes his teacher Apollobeches the Copt, which Mallet[11] thinks is Egyptian, Hor-bak, 'Horus the falcon' (since Apollo = Horus). Demokritos said that he learnt very little in his travels,[12] and perhaps his only teacher was Leukippos, whom Aristotle[13] calls the 'associate (ἑταῖρος)' of Demokritos.[14] Demokritos certainly visited Athens, perhaps in later life, but, he says 'no one knew me'; it is suggested that this included Sokrates.

Demokritos is said by Cicero[15] to have been a master of style, ranking with Plato. Seneca[16] called him 'the most subtle of all the ancients'. Dante[17] ranked him immediately after Sokrates and Plato. He was kindly, free from vanity, possessed of sound common-sense, and imbued with the true scientific spirit, a combination of qualities rare in a Greek.[18] He said 'insight is better than much learning (πολλοὶ πολυμαθέες νόον οὐκ ἔχουσι)'.[19] His nickname 'the laughing philosopher' appeared only in the Roman period.[20] He abandoned without fuss views shown to be mistaken.[21] The story of the visit of Hippokrates to him[22] is apocryphal.

Anaxagoras and Empedokles (see pp. 22, 17) had made experiments but

[1] Diogenes Laertios, ix, 34–6; Diodoros Siculus, i, 96, 98; Pliny, xxx, 2; Clement of Alexandria, *Stromateis*, i, 15; Strabo, XV, i, 38, p. 703 C; Suidas, *loc. cit.*; Mallet, 97, 138 f.

[2] Diogenes Laertios, ix, 39–40.

[3] Diogenes Laertios, ix, 38; Loukian, *The Liar*, 32; (1), iii, 248.

[4] Diogenes Laertios, ix, 47.

[5] Zeller, (1), I, ii[6], 1047 (he was certainly in Egypt and probably in Asia Minor and Persia, but not India); Orr, *Dante and the Early Astronomers*, 1913, 62 f.; Mallet, 139 (little doubt that he visited Egypt; he may have visited Ethiopia, Babylonia, and Phrygia); C. Bailey, (1), 110 (nothing improbable in his travels to Egypt); Hopfner, *Beih. a. O.*, 1925, iv, 10 (doubts visit to Egypt); E. Meyer, (1), v, 340; Müller, PW, ii, 355; Nestle, (1), 59; A. Schmidt, 7; Scoon, 198 (extensive travels); Ueberweg, (1), i, 105; Wellmann, PW, v, 135; *id.* in VS, ii, 208.

[6] (1), 68; but cf. Hopfner, 40; Zellar, (1), I, i[7], 28; I, ii[6], 1048; III, ii[3], 244.

[7] Hopfner, 18; Zeller, (1), I, ii[6], 1046.

[8] *Apollonios of Tyana*, i, 2.

[9] VS, ii, 218; Hopfner, 6.

[10] xxx, 1.

[11] 139.

[12] Mullach, (2), 332, from Clement of Alexandria.

[13] *Metaph.*, i, 4, 985*b*.

[14] Dyroff, 7; Zeller, I, ii[6], 1047.

[15] *De orat.*, I, xi, 49.

[16] *Quaest. Nat.*, vii, 3.

[17] *Inferno*, iv, 136.

[18] Baumgarten, (1), 537.

[19] Zeller, (1), I, ii[6], 1139.

[20] C. Bailey, (1), 112.

[21] VS, ii, 93.

[22] Hippokrates, *Opera*, ed. Kühn, Leipzig, 1827, iii, 775.

Demokritos laid special emphasis on them.[1] Two of his experiments, both quantitative,[2] are reported.

(1) Aristotle[3] mentions an experiment probably made by Demokritos (although he does not say this) to prove the existence of a void; a measure filled with ashes (τέφρα) holds as much (ἴσον) water as the empty vessel. The water was supposed to enter the empty pores of the ashes, or vice versa. Perhaps the ashes assumed a closer packing when wet, or partly dissolved in the water as potassium carbonate without much change of volume.

(2) Seneca[4] reports an experiment in which vessels of copper, glass, and silver are set in the sun. 'The heat will penetrate the copper one soonest and will remain in it longest'; harder, more compact, and dense bodies have pores smaller than in others, and in each of these the air is thinner (et tenuiorem in singulis spiritum). 'These hidden openings, so small as to elude the eye, feel the heat more quickly [small bodies heat more quickly than large ones] and on account of this same smallness of calibre give back more slowly the heat they have received.'

Works of Demokritos

The writings of Demokritos were lost in the time of Simplikios (*c.* A.D. 533), although Cicero (d. A.D. 43) had the whole of them; they probably still existed in the 3–5 cents. A.D.[5] Now only fragments remain.[6] The writings were very extensive and perhaps included works of his school.[7] There are five main groups: (1) Ethics, (2) Physics (the largest),[8] (3) Mathematics, (4) Music, (5) Technical Arts (τεχνικα). Demokritos, before Aristotle (who had his works as a model), attempted to reduce the whole of extant knowledge into a system, and the titles indicate his varied interests and encyclopaedic knowledge.[9] Some of the titles are:

The Great World (Μέγας Διάκοσμος); *The Little World* (Μικρὸς Διάκοσμος); *Of Nature* (Περὶ Φύσεος) in two books; *On Planets* (Περὶ τῶν Πλανήτων), *On the Nature of Man or On Flesh*, *On Colours*, *On Juices*, *On Shapes* (of atoms), *On Causes of Fire and Things in Fire*, *Aerial Causes*, *Causes of Seeds, Plants, and Fruits*, *Causes concerned with Animals*, *On the Maghet* (Περὶ τῆς Λίθου),[10] *On Agriculture or Land Measurement* (perhaps a work of Bolos of Mendes),[11] *On Medical Regimen*, *On Painting*, *On Tactics*, etc. *Handicraft* (χειρόκμητα) is probably by Bolos of Mendes (see p. 211). 'Sayings (*Gnomae*)' attributed to

[1] Donkin, DBM, i, 165; Dyroff, 46, 160; Rosenberger, i, 14.
[2] Tasch, *Isis*, 1948, xxxviii, 185.
[3] *Phys.*, iv, 6, 214*a*; Brieger, *Hermes*, 1902, xxxvii, 56; Diels, *ib.*, 1905, xl, 301; Dyroff, 172; Gomperz, (2), i, 352; E. Oder, *Philologus Suppl.*, 1898, vii, 229; Ueberweg, (1), i, 107; Zeller, (1), I, ii[6], 1057.
[4] *Quaest. Nat.*, iv, 9; Oltramare, *Sénèque, Questions Naturelles*, 1929, ii, 201, 341, thought it incredible that Demokritos should have supposed copper denser than silver.
[5] Windelband, in Iwan Müller, 1888, V, i, 207 f.
[6] F. G. A. Mullach, (1); *id.*, (2), 330–82; Freeman, (2), 91–120 (309 fragments); VS, ii, 92–207.
[7] Diogenes Laertios, ix, 46–9; Mabilleau, 152 f.; VS, ii, 90.
[8] Zeller, (1), I, ii[6], 1052.
[9] C. Bailey, (1), 116; Dyroff, 23, 40.
[10] Literally 'on the stone', but V. Rose, *Aristoteles Pseudepigraphus*, 1863, 242, suggested the probable title.
[11] Mullach, (1), 150.

Demokritos, or to Demokrates (an agricultural author, 4 cent. B.C.), include abbreviations of genuine fragments.[1]

Diogenes Laertios[2] says Plato (perhaps in his old age)[3] wished to burn the writings of Demokritos, but was dissuaded, since they were already widely circulated; Diogenes comments on the fact that Plato never mentions Demokritos by name.[4] Aristotle, who criticised the atomic theory adversely, speaks of Demokritos with respect, ranking the atomists above other natural philosophers and even Plato, since they, particularly Demokritos, had found a correct and natural basis for their investigations and pursued these in a methodical way.[5] The works of Demokritos were carefully studied and the theory was never forgotten.[6]

Atomic Theory of Demokritos

The contributions of Demokritos to the atomic theory were probably mainly seven:[7]

1. A clearer definition of empty space as the 'un-real' (οὐκ ὄν) as distinguished from the 'not-real' or 'non-existent' (μὴ ὄν). Plutarch says Demokritos, by cutting off the negative part of τὸ μηδὲν ('nothing'), made a new word τὸ δὲν ('othing') to express substance, and said 'there is an othing as well as a nothing (μὴ μᾶλλον τὸ δὲν ἢ τὸ μηδὲν εἶναι)'.[8]

2. The clear statement of the principle of conservation of matter: 'nothing is created out of nothing (or the non-existent) or is destroyed into nothing (or the non-existent) (μηδέν τε ἐκ τοῦ μὴ ὄντος γίνεσθαι μηδὲ εἰς τὸ μὴ ὂν φθείρεσθαι).'[9]

3. Necessity (ἀνάγκη, *ananké*, i.e. natural law) orders all things, not 'chance' (τύχη), or creative purpose, or 'love and strife', or 'mind'.[10]

4. The atoms are unbreakable because they are hard, not because they are exceedingly small.[11]

5. The atoms have weight (but see below).

6. The extension of the theory of combination of atoms due to Leukippos.

7. If the argument in Aristotle[12] is from Demokritos, he and not Epikouros distinguished between mathematical and physical divisibility, admitting that the first is possible to infinity but the latter finds a limit in the atom.[13]

[1] Freeman ,(2), 99; VS, ii, 153. [2] ix, 40.
[3] Masson, *Lucretius, Epicurean and Poet*, 1907, 305.
[4] J. Adam, 268; Frank, 65, 120; Ruska, *Isis*, 1924, vi, 48; A. E. Taylor, (1), 3; the newer dates for Demokritos make him almost contemporary with Plato and his works may not have arrived in Athens until Plato was writing the *Timaios*, the theory of colours in which seems to be based on them; Hammer Jensen, *A. Phil.*, 1910, xxiii, 92, 211; Kranz, *Hermes*, 1912, xlvii, 126 (137); E. Sachs, 186, 206.
[5] *De gen. et corr.*, i 2, 316*a*; Frank, 119; Scoon, 209; Ueberweg, (2), i, 68; Zeller, (1), I, ii[6], 1058.
[6] Dyroff, 61 f., 161, 165.
[7] C. Bailey, (1), 117 f., 136, 213; Mullach, (1), 376 f.
[8] Mullach, (1), 421 (δέν = τὸ ὄν in Aristotle); Ueberweg, (1), i, 106; VS, ii, 174.
[9] Diogenes Laertios, ix, 44; Cudworth, i, 68; Mabilleau, 429.
[10] C. Bailey, (1), 121, 186.
[11] Aristotle, *De gen. et corr.*, i, 2, 316*a*.
[12] *De gen. et corr.*, i, 2, 317*a*.
[13] Hammer Jensen, *A. Phil.*, 1910, xxiii, 102, 212 (from Simplikios); Zeller, (1), I, ii[6], 850, 858.

The reality of empty spaces between atoms was demonstrated by the existence of motion, by the rarefaction and condensation of bodies, by organic growth depending on the penetration of nutriment, and by the experiment described on p. 40.[1] The atoms are all of the same substance, since only in this way could they act upon one another. The differences of bodies cannot be referred to different properties of the atoms, and since no qualitative differences among atoms are assumed, they can differ only quantitatively; in form (σχῆμα, *schema*, or ἰδέα, *idea*), order (τάξις, *taxis*), and position (θέσις, *thesis*), in some unspecified way.[2] Aristotle illustrated this (probably from Demokritos) with letters: A differs from N in shape, AN from NA in arrangement, and I (the older form of Z) from H in position; this can be extended in combinations such as ANH, AHN, AIN, ∀HN, an anticipation of isomerism.

The atoms also differ in size (μεγέθει, *megethei*), perhaps extensively.[3] Demokritos thought the spherical atoms were smallest.[4] Aristotle[5] says the atomists (Leukippos and Demokritos) assumed fire atoms to be spherical but left the shapes of others undetermined; there were, however, 'infinitely many forms', in opposition to Plato's figures.[6] This (almost) infinite variety was necessary, since each specific substance implied a special variety of atom; 'the atom itself had to fulfil the task that is performed in modern science by the molecule, and its richer variety was an obvious condition.'[7] There was no logical reason why an atom should not be very large, even as large as the world, provided that it is physically indivisible, but atoms are actually so small as to be invisible.[8] Aristotle[9] tried to refute the theory that the atoms are of different sizes, but his argument assumed only *finite* numbers of each, whilst he had just said that Demokritos supposed that the atoms 'are infinite in number'.

Demokritos, in spite of what Aristotle says, seems to have speculated on the forms of atoms other than those of fire, especially in relation to tastes, which depend on atomic figures (sour, from angular, winding, small and thin particles; sweet from spherical and not too small particles, etc.).[10] He does not explain odours, saying only that smell is caused by what is fine flowing off from what is heavy.[11] He explains the sensation of touch, and heavy and light; iron is harder but lighter than lead because iron atoms are unevenly packed, and it has more space as a whole but is densely packed in certain places; lead is more evenly packed but contains less space.[12]

[1] Ueberweg, (1), i, 107.
[2] Aristotle, *Metaphys.*, i, 4, 985*b*; viii, 2, 1042*b*; C. Bailey, (1), 80; Zeller, I, ii[6], 1061, 1067.
[3] Aristotle, *Phys.*, iii, 4, 203*b*; Dyroff, 171; Zeller, (1), I, ii[6], 1064.
[4] Zeller, (1), I, ii[6], 1066 (from Philoponos).
[5] *De cœlo*, iii, 4, 303*a*; *De gen. et corr.*, i, 8, 326*a*; on the text see Prantl, (1), 1857, ii, 408, with whom Zeller, (1), I, ii[6], 1054, disagrees.
[6] Brieger, 15. [7] Gomperz, (2), i, 332.
[8] Zeller, (1), I, ii[6], 1065 (Stobaios, *Eklog. Phys.*, I, xiv, p. 348, ed. Gaisford); VS, ii, 95 (Eusebios).
[9] *De cœlo*, iii, 4, 303*a*–*b*.
[10] Theophrastos, *De caus. plant.*, vi, 1–2; *De sensu*, 49 f.; Beare, 163; Burchard, *De Democriti ... de sensibus, philosophia*, Dissert., Minden, 1830; VS, ii, 113; Zeller, (1), 1892, i, 866;.
[11] Theophrastos, *De sensu.*, 82; Beare, 137; Diels, VS[6], ii, 123.
[12] Theophrastos, *De sensu.*, 62; VS, ii, 117; Freeman, (1), 1949, 314.

The question whether Demokritos attributed weight to atoms is difficult and both ancient and modern authors differ. Aristotle says Demokritos regarded atoms as heavier 'according to excess' (βαρύτερον γε κατὰ τὴν ὑπεροχήν φησιν εἶναι Δημόκριτος ἕκαστον τῶν ἀδιαιρέτων; atqui Democritus indivisibilium quodque per excessionem gravius esse asserit).[1] Theophrastos[2] more definitely says that he distinguished heavy and light atoms according to size (βαρὺ μὲν οὖν καὶ κοῦφον τῷ μεγέθει διαιρεῖ Δημόκριτος; gravia ergo et levia magnitudine distinguit Democritus). Atanassiévitch (see p. 44) thought that Aristotle's criticism of Demokritos could have been made more severe if the atoms had weight.

The attribution of weight to atoms by Demokritos is accepted by many.[3] Others[4] think the older atomists had no clear idea of gravitation or the necessity of falling, and what Aristotle called 'weight' is really what we call 'inertia'. Inertia, however, is a less primitive and more difficult idea than weight, which is familiar in the transactions of daily life. It is suggested[5] that the proportionality of weight to size refers to aggregates of atoms, in which case the proportion of pores in the mass must be taken into account (this is rejected by Zeller). C. Bailey[6] says the atomic motion, present from the beginning, is called by Demokritos 'vibration (παλμός)', not perpendicular fall; he thinks the Demokritan atom had something called 'weight', but not absolute weight; atoms were only 'heavier and lighter' and their 'weight' was only a derivative property of size. Demokritos (not Leukippos) probably brought in weight to explain the movement of atoms hither and thither (a kind of Brownian movement, rather than perpendicular fall as it was for Epikouros).

Aristotle[7] says Demokritos compared the motion of soul atoms to that of dust particles in a sunbeam in a room; these are seen to be perpetually in motion even when the air is completely still (διότι συνεχῶς φαίνεται κινούμενα, κἂν ᾖ νηνεμία παντελής), and he probably thought that other atoms moved in the same way. Theophrastos[8] says Demokritos reckoned 'weight and lightness' among the 'sensible' (not real) qualities of atoms; and Dyroff[9] thinks Demokritos did not attribute weight and lightness as primary properties of atoms, but only to atoms of earth, as sensible qualities, yet not wholly subjective. This vagueness was criticised by Aristotle, who could not have known of Epikouros's theory.[10] Stobaios[11] says Epikouros added weight (βάρος) to size and shape (μέγεθος τε καὶ σχῆμα) of the atoms, but Demokritos did not (βάρος μὲν οὐκ ἔχειν). Zeller[12] thought weight was regarded by

[1] Aristotle, *De gen. et corr.*, i, 8, 326*a*; *Opera*, Paris, 1850, ii, 449; *De cœlo*, iv, 2, 309*a*.
[2] *De sensu*, xiii, 61; *Opera*, Paris, 1866, 333.
[3] Baeumker, 312; Deussen, (1), II, i, 141; Gilbert, 139; Hammer Jensen, *A. Phil.*, 1910, xxiii, 95, 211 (222); Mabilleau, 194; Ueberweg, (1), 107; Zeller, (1), I, ii[6], 1066, 1073, 1084 f. (es steht ausser Zweifel; see Nestle's note, 1085).
[4] Brieger, 5; Burnet, (1), 341 f.; Kroll, ERE, ii, 198; H. C. Liepmann, *Die Mechanik der Leucipp-Democritischen Atome*, Leipzig, 1886, 31; Mullach, (1), 381; Windelband, (1), 42.
[5] C. Bailey, (1), 92 f.; Brieger, 5.
[6] (1), 92, 94 f., 129 f., 132 f.; *id.*, (2), 202.
[7] *De Anima*, i, 2, 404*a*; *Opera*, Paris, 1854, iii, 433: ἐν τῷ ἀέρι τὰ λαλούμενα ξύσματα; Burnet, (2), 96.
[8] *De sensu*, xiii, 6.
[9] 31 f., 35, 39.
[10] Gilbert, 139.
[11] *Eklog. Phys.*, I, xiv, ed. Gaisford, 348; Teubner ed., 1860, i, 93.
[12] (1), I, ii[6], 1068.

Demokritos as self-evident, but Epikouros considered that it required explanation. Aëtios[1] also says Epikouros first added weight as a property of atoms, and Cicero,[2] who was hostile to Epikouros, gave him credit for this. C. Bailey[3] thinks the assumption of absolute weight of atoms did not originate with Epikouros but was taken by him from an earlier Demokritan, possibly Nausiphanes (p. 48). Epikouros may have attributed 'weight' only, not 'heaviness and lightness', to atoms, and regarded it as the cause of *perpendicular* fall, in consequence of the criticism of Demokritos' theory by Aristotle.[4]

Zeller made an unjustified extension of the texts, which seemed obvious to him,[5] and the expert studies of Burnet and Bailey must be accepted as authoritative, yet it seems reasonable to suppose that Demokritos assumed that large and small atoms have *masses* proportional to their sizes or the quantities of uniform matter which they contain, and this is what a chemist would call different 'weights'.

The densities of bodies depend on the proportions of empty space among their atoms. Bodies are formed by the association (συνεχές) of atoms, which apparently were regarded as in contact, and when the body passes away the atoms disperse.[6] The hardness of bodies depends on the proportion of empty space, bodies with more being softer, since their atoms are more easily displaced.[7] Bodies with more space are of a warmer nature.[8] Leukippos and Demokritos regarded the interstitial spaces in bodies as *absolutely* empty (κενὰ); Anaxagoras's 'pores' (κοῖλα) were not.[9]

The way in which atoms collect into bodies was regarded by Demokritos as purely mechanical; neither he nor the later atomists had any idea of attractive forces between atoms. 'Sociable' particles had means of mechanical attachment owing to the shapes of their surfaces, e.g. 'hooks and eyes', and some could be attached at one, others at two points (double bonds).[10]

> Simplikios says Demokritos taught that: 'the reason why the atoms remain for a certain time in combination (συμμένειν) is because they fit into and grasp (διὰ τὰς ἐπαλλαγὰς καὶ ἀντι λήψεις) one another, for some of them have uneven sides and some are hooked, some are concave and some convex and others have innumerable varieties of shape. He thinks that they hold on to one another and remain in combination until some stronger necessity (ἀνάγκη) from what surrounds them comes and shakes (διασείσηι) them and scatters them apart.'[11]

Aristotle[12] places Empedokles and Demokritos together as explaining coming into being by 'the secretion of what was before existent, as when divers things

[1] *De Placit. Philos.*, i, 3; in Plutarch, *Morals*, tr. Holland, 1603, 807.
[2] *De fato*, xx, 46; ed. Mueller, Leipzig (Teubner), 1878, 269: Aliam enim quamdam vim motus habebant a Democrito impulsionis, quam plagam ille appellat; a te Epicuri, gravitas et ponderis.
[3] (1), 129.
[4] Atanassiévitch, 1927, 51 f.; Dyroff, 1899, 31 f., 39; Freeman, (1), 1949, 301; VS, ii, 100.
[5] Scoon, 202.
[6] Aristotle, *Phys.*, iii, 4, 203*a*; Zeller, (1), I, ii[6], 1066, 1069, 1072.
[7] Burnet, (1), 1920, 344; A. E. Taylor, (1), 489; Windelband, 112; Zeller, I, ii[6], 1072.
[8] Deussen, (1), II, i, 142.
[9] Dyroff, 28; cf. *ib.*, 49 f. for relations of the atomic to older Greek theories.
[10] Brieger, 15; Gomperz, (2), i, 334.
[11] VS, ii, 93, 95; C. Bailey, 1928, 136.
[12] *De cœlo*, iii, 7, 305*b*.

mixed in a vessel are separated'. Demokritos[1] said: 'Living creatures consort with their kind. . . . So it is with inanimate things, as one can see from the sieving of seeds and with the pebbles on beaches. . . as if the similarity in these things had a sort of power over them which had brought them together (ἐχούσης τῶν πραγμάτων).' This implies that only their similarity in *shape* brings bodies together when they are shaken about or jostled. Simplikios says Demokritos taught that the atoms 'are entangled in such a way that they touch and are near one another, yet never make in truth any single existence'.[2] Cicero[3] quotes Straton as saying that worlds were made without the intervention of God, 'yet not in such a manner as he [Demokritos] affirmed them to be, all concreted out of certain rough and smooth, hookey and crooked atoms (qui asperis et lævibus et hamatis uncinatisque corporibus concreta), these being dreams and dotages of Demokritos (somnia censet haec esset Democriti, non docendis sed optantis)'.

Aristotle[4] says Demokritos put things down to 'natural causes, as it was so at first', but the beginning of eternity is not to be sought after. Demokritos's idea of 'chance' (ἀνάγκη, necessity) in the production of aggregates in the vortex (δίνη) is similar to Boltzmann's definition of entropy. It was a 'cause unascertainable for human reason'.[5] There are special conditions of shape, size, position, order, and movement of the atoms, which work themselves out according to perfectly definite laws of causality, but we cannot know these because the conditions are below the threshold of our perception and we attribute the result to 'chance'; 'something *must* be left undetermined.'[6] The real meaning of ἀνάγκη is not 'a blind unconscious force', as Archer-Hind[7] said, but what he attributed to Plato: something 'working strictly in obedience to a certain law . . . for the most part as inscrutable to us as if it acted from arbitrary caprice'.[8]

The aggregates of atoms are first formed by jostling and entangling, and then fall into a vortex motion, in which a cosmos with an earth, air, sky, and heavenly bodies, is produced by like particles coming together.

Like Leukippos (p. 35), Demokritos regarded the motion of atoms as 'natural' and not requiring explanation; Aristotle[9] says the atomists thought 'the cause of motion is the empty space, in the sense that it is that in which motion happens (ὡς ἐν ᾧ κινεῖται)'. Motion caused by a 'blow' in collisions is a rebound, and an atom caught up in a vortex of atoms is moved by 'force'.[10] The difficulty that a chemical compound has different properties from its components was not felt by Demokritos;[11] it was realised by Aristotle and was

[1] VS, ii, 176; Freeman, (2), 1948, 107.
[2] C. Bailey, (1), 346, thinks this implies atomic motion in the compound, but this is not necessarily the case.
[3] *Quaest. Academ.*, iv, 38; *Opera*, ed. Gronovius, Leyden, 1692, ii, 1080; Cudworth, 1845, i, 149; ii, 620; VS, ii, 104.
[4] *Phys.*, viii, 1, 252.
[5] Theodoret, q. by C. Bailey, (1), 143; Freeman, (1), 1949, 303; VS, ii, 101, 180.
[6] Planck, *Acht Vorlesungen über theoretische Physik*, 1910, 97.
[7] *The Timaeus of Plato*, 1888, 161, 167.
[8] Partington, *Ann. Sci.*, 1939, iv, 245.
[9] *Phys.*, iv, 7, 214*a*.
[10] C. Bailey, (1), 134–5; the terms are attributed by Simplikios to Demokritos.
[11] Gomperz, (1), 1903, i, 263 f.; Dyroff, 170.

one of his objections to the atomic theory. It was a principle for Demokritos that 'like assorts with like':[1] Demokritos was unique in believing that only likes can affect, or be affected by, one another, and that if unlikes appear to do so it is only in so far as they are like.[2]

One of the most important features of the old atomic theory (Burnet thought it went back to Leukippos) is the distinction between 'primary and secondary', or 'objective and subjective', properties (these names are much later), thus anticipating John Locke by many centuries.[3] This distinction was even more sharply drawn by Epikouros.[4] Parmenides had regarded taste, colour, and sound as 'derived' as distinct from the 'real' qualities[5] and Philolaos, after him, had the distinction φύσει-νόμωι.[6] The doctrine was expressed by Demokritos in a famous aphorism:

νόμῳ γλυκὺ καὶ νόμῳ πικρόν, νόμῳ θερμόν, νόμῳ ψυχρόν, νόμῳ χροιή. ἐτεῇ δὲ ἄτομα καὶ κενόν

'in appearance (νομῷ = by law) are sweet and bitter, heat and cold, and colour; in truth (ἐτεῇ) are atoms and a vacuum.'[7] Shape, size, hardness (and perhaps weight) of the atoms are true properties, never apprehended by the senses; colour, smell and taste are sense impressions and correspond with no 'real' existences. Demokritos distinguished 'genuine knowledge' and 'obscure knowledge' (through sense perceptions), but was doubtful if *any* knowledge is really certain.[8] In perception the primary qualities act upon the organs of sense.

The mind or soul consists of small, smooth and spherical atoms of fire, distributed through the body, one between each pair of atoms.[9] The fire atoms are distributed over the whole world, but most plentifully in man, and perception is due to the action of objects on the fire atoms of the soul.[10] Gilbert[11] thinks Demokritos identified the rapid motion of the fire atoms with heat. The soul (ψυχή) is the most important part of man, the body (σκῆνος) is its 'vessel'; the soul is mortal and perishes with the body.[12] Diminution in the number of fire atoms in the body is prevented by their absorption from the air in respiration, which replaces those lost and also hinders their egress. Suffocation leads to death because the fire particles escape and they cannot be replaced when they have all left the body; in sleep only a few escape.[13] Leukippos had taught that 'respiration is the limit of life', the one ceases with the other.[14] Demokritos asserted that there were no quite certain signs that life has ceased and

[1] C. Bailey, (1), 138 f.; Ueberweg, (1), i, 107; Zeller, (1), I, ii[6], 1076, 1096.
[2] Aristotle, *De gen. et corr.*, i, 7, 323*b*; Freeman, (1), 1949, 302.
[3] Burnet, (1), 347 f.; Zeller, (1), I, ii[6], 1071 f.
[4] Dyroff, 71 f., 121 f. [5] Diels, (5), i, 34 f. [6] VS, i, 410.
[7] Diogenes Laertios, ix, 72; Sextos Empirikos, *Adv. Math.*, vii, 135, ed. Fabricius, Leipzig, 1742, ii, 310; Galen, *De elementis ex Hippocrat.*, in *Opera*, ed. Kühn, i, 417; VS, ii, 84, 97, 168; C. Bailey, (1), 178; Zeller, (1), I, ii[6], 1058 (says καὶ in line 1 should be omitted).
[8] C. Bailey, (1), 177 f.; Stahr, DBM, i, 976; Windelband, (1), 112; Zeller, (1), I, ii[6], 1072.
[9] Scoon, 214; Windelband, (1), 113; Zeller, I, ii[6], 1116 f.
[10] Zeller, (1), I, ii[6], 1116. [11] 150.
[12] C. Bailey, (1), 160; Zeller, (1), I, ii[6], 1119.
[13] Sprengel, (1), 1815, i, 265 (compares with Crawford's theory of animal heat); Zeller, (1), I, ii[6], 1117.
[14] C. Bailey, (1), 103, 158.

assumed a limited continuation of life in the body after death;[1] the hair and nails grow after death. He was very interested in biology, and is perhaps the one who is reported as saying that men were generated either from small worms or eggs.[2] His theory of vision[3] has been attributed to Leukippos, but Clement of Alexandria[4] says Demokritos added it to the teachings of Leukippos, perhaps by making the air the intermediary.[5] Demokritos supposed that images or 'idols (εἴδωλα)' are constantly thrown off from the surfaces of things, forming similar shapes in the air which enter the eye and cause vision.[6] E. A. Taylor[7] supposed that the images were not regarded as material but as 'undulations' in the air, but this would contradict the whole system of atomism.[8] Some images might not act on the senses of an ordinary man, but might on 'other senses'. Thought is a contact of fire-particles with the finest images, respresenting the atomic structure of things. Dreams are due to images which entered in the waking state but, on account of their weak motions, previously produced no impression, or had first reached the fire-atoms in sleep. The action of one mind on another, and faith in gods or demons (which produce images from giant forms in infinite space) is then understandable.

The gods are visions present in the air; they also impinge on animals, which have some conception of divinity.[9] Belief in gods arose from terrifying natural phenomena such as thunder and lightning, and eclipses. For Demokritos, the gods have become demons which, since their images may come from afar, can give warnings of the future.[10] He was apparently the first Greek philosopher to distinguish good and evil demons, which suggests Persian influence; this was extended by the Stoics and later schools, culminating in Proklos.[11] Evil persons can emit images to injure others.[12] The magnet emits effluxes from its own atoms which penetrate the pores of iron and displace the iron atoms, which return to the magnet and carry the iron with them.[13]

Demokritos recognised four 'primary' colours: white, black, red, and yellow.[14] The names of the first three (λευκός, μελάνος, ἐρυθρός) are the same in all the authors. The fourth is ὤχρος (Aëtios), ξανθός (Galen), χλωρός (Theophrastos). The last, greenish-yellow, is preferred by Beare, Diels, von Fritz, and Mullach, but it is probably a mistake for ὠχρός, which can mean pale yellow, egg-yolk yellow, pale buff or khaki (Taylor). The meaning of ξανθός is tawny yellow, like ripe corn, honey, or wine; χλωρός may also mean

1 Waszink, 528–9, and refs.

2 Aristotle, *De gen. animal.*, iii, 11, 762; Dutens, (2), 278–85; Freeman, (1), 1949, 306–8.

3 C. Bailey, (1), 103 f., 165 f.; Windelband, (1), 114; Zeller, (1), I, ii[6], 1126.

4 *Exhort*, ch. 5. 5 C. Bailey, (1), 168. 6 Zeller, (1), I, ii[6], 1126. 7 487.

8 Andres, PW, Suppl. iii, 292; Zeller, (1), I, ii[6], 1116, 1126.

9 Freeman, (1), 1949, 315; VS, ii, 104. 10 Zeller, (1), I, ii[6], 1161.

11 Andres, PW, Suppl. iii, 292; Hopfner, PW, 1928, XIV, i, 309.

12 Plutarch; Freeman, 1949, 315; VS, ii, 103.

13 Alexander of Aphrodisias who says this does not explain the power of amber to attract chaff, since these are dissimilar things; VS, ii, 128.

14 Aëtios, *Placita*, I, xv, 8 (VS, ii, 112–14); Galen, *De elem. sec. Hippocr.*, i, 2 (*Opera*, Kühn, i, 417; VS, ii, 97); Theophrastos, *De sensu*, 73 f. (*Opera*, Wimmer, Paris, 1866, 336); C. Bailey, (1), 169; Beare, 25, 30, 33, 52; Dyroff, 176 f.; Freeman, (1), 1949, 311; von Fritz, in Singer, 4), i, 83; Gomperz, (1), i, 267; Joachim, *Aristotle's Coming to Be* Oxford, 1922, 75; (Kranz, *Hermes*, 1912, xlvii, 126; Mullach, (1), 220; (2), 363; A. E. Taylor, (1), 281,479 f., 483; Zeller, (1), I, ii[6], 1075.

sandy yellow, or the colour of honey or the metal electrum; 'green' would be one possible meaning.

These four colours are found on Attic vases before and after the 6 cent. B.C.[1] The same four colours are in Herakleitos[2] and Loukian;[3] also in Empedokles, who relates them to the four elements.[4] In Plato's *Timaios* fire is white and earth is black.[5] The four colours may be of Pythagorean origin[6] and connected with the *tetraktys* (p. 12).

Pliny[7] reported that the old Greek painters used only four colours (white *melinum*, yellow *sil*, red *sinopis*, and black *atramentum*), but in his time purple, and blue indigo, were used. Prehistoric colours[8] (in actual specimens) are red (raddle, iron oxide), yellow ochre, carbon black, and white earth, chalk or gypsum; a comprehensive description was first derived for the concept red, additions in the prehistoric period were yellow, black and white; 'general designations for green and blue appeared much later.'[9] The same four colours appear in old Egyptian, Babylonian (lists of the planets) Chinese and Mexican accounts.[10]

Aristotle[11] said Demokritos attributed differences in colour to differences in position (τροπή) of the atoms, Theophrastos[12] that white, black, and red are caused by differences of shape and texture (rough and smooth) as well as size of the atoms, whilst yellow (green ?) involves the participation of the vacuous space (τοῦ κενοῦ).[13] An anonymous 14-cent. Naples MS.[14] says the 'physicists (Physici)' taught that there were three primary colours, black, white, and red; yellow (glaucus, sive auripigmentum, vel aurum finum, sive croceum) was added later, whilst blue, violet, and rose were still later included to make seven. In the old list blue and black, and green and yellow, were perhaps regarded as interchangeable; the Arabic atomists separated green from yellow and had five colours.[15] Demokritos explained in detail how other colours were formed by mixture: purple of much red, a little black, and a medium quantity of white, etc.[16] The meaning of his saying 'the eagle has black bones (ὀστᾶ μέλανα)'[17] is not clear.

Anaxarchos of Abdera (fl. 340 B.C.), a Demokritan although he studied under Diogenes of Smyrna, accompanied Alexander the Great into Asia. They met the Magi, and the Gymnosophists of India. Anaxarchos is reputed to have instructed Alexander, but in what is not recorded. After Alexander's death he settled in Cyprus, where he was pounded to death in a mortar.[18]

Nausiphanes of Teos (4–3 cents. B.C.), the teacher of Epikouros, wrote *The Tripod*,

[1] Baumgarten, (1), 187 f. [2] VS, i, 153, from ψ-Aristotle, *De Mundo*.
[3] *Sale of Creeds*, 13; (1), i, 196; he groups Herakleitos and Demokritos as 'a superlative pair, Lot no. 4', unsold, in his auction.
[4] Gomperz, (1), i, 204; Zeller, (1), I, ii[6], 994. [5] A. E. Taylor, (1), 482.
[6] ψ-Plutarch, *De Placitis Philosophorum*, i, 15; A. E. Taylor, (1), 482.
[7] xxxv, 32, and note in Bostock and Riley's tr., 1857, vi, 245.
[8] C. Burkitt, *Prehistory*, Cambridge, 1925, 205. [9] Schrader, (1), 230–3.
[10] Jeremias, 1913, 85; yellow = greenish-yellow.
[11] *De gen. et corr.*, i, 2, 316*a*. [12] *De sensu*, 73 f. [13] A. E. Taylor, (1), 281 f.
[14] *De arte illuminandi*, ed. de la Marche, *Mém. Soc. Nat. des Antiquaires de France*, 1886, xlvii, 252.
[15] Maimonides, *Guide to the Perplexed*, tr. Friedländer, 1885, i, 324, *n*. 3.
[16] Kranz, *Hermes*, 1912, xlvii, 126 (139), less definitely for indigo and κάλλιστον χρῶμα.
[17] VS, ii, 147.
[18] Ueberweg, (1), i, 110, 463; VS, ii, 235; Zeller, (1), I, ii[6], 1188.

preserved in summary by Philodemos and said to have been the source of the *Canon* of Epikouros. He expounded the works of Leukippos and Demokritos, Anaxagoras and Empedokles, and emphasised the value of science and rhetoric. He taught that the goal of life is immovability (ἀκαταπληξία), and that among apparent existences 'nothing exists more than it does not exist'.[1] He may have introduced the idea that atoms have weight, and since Epikouros was not much interested in physical theory he may well have got this from Nausiphanes.[2] Nausiphanes was a pupil of Pyrrhon (360–270 B.C.) who accompanied Alexander the Great into Asia and founded Pyrrhonism or Scepticism — the nature of things is not to be known and judgment must be suspended.[3], Other Demokritans were Diotimos of Tyre (date unknown)[4] and the mathematician) and astronomer Bion of Abdera (4 cent. B.C.) who gave a classification of the four winds.[5]

[1] Freeman, (1), 1949, 335; (2), 124; Ueberweg, (1), i, 110, 442, 464; VS, ii, 246; Zeller, (1) I, ii[6], 1191.

[2] C. Bailey, (1), 129, 218, 289, 311.

[3] Ueberweg, (1), i, 462; Zeller, (2), 241.

[4] Von Arnim, PW, v, 1150.

[5] Hultsch, PW, iii, 485.

CHAPTER III

PLATO

The Athenians in the 5 cent. B.C. disliked speculative philosophy, but Anaxagoras was followed there by numbers of so-called Sophists, professional teachers of young men destined for politics or law. Emphasis was laid on verbal argument and quibbles: 'how many stones make a heap?', 'have you left off beating your wife?'[1] This method of 'dialectic (διαλεκτικός)', as Plato called it, was turned to better use by Sokrates of Athens (469–399 B.C.),[2] whose teachings are known only in different and probably altered accounts in Xenophon and Plato. At first interested in scientific philosophy by Archelaos, a pupil of Anaxogoras, he came to the conclusion that nothing certain can be ascertained about the external world, and turned his attention to moral philosophy,[3] insisting on exact definitions and using the legal method of cross-questioning. He is said to have been friendly with the Pythagorean Kebes.[4] His ideas are of little interest to us.

The Cynics (κυνικοί, from κύων, dog), founded by Diogenes of Sinope (*c.* 400–325 B.C.), were never a school but isolated philosophers who followed the teachings of Antisthenes of Athens (*c.* 455–360 B.C.). They flourished in the 3 cent. B.C., then died out but revived in the 1 cent. A.D. and were active till the 5 cent. A.D. as opponents of the Stoics.[5]

PLATO

Plato (*Πλάτων*) (Athens; 427–347 B.C.), of distinguished family, became a pupil of Sokrates. He visited Sicily and Italy in 387, meeting Archytas of Tarentum. On his return to Athens he founded the Academy (*Akademia*) about 385, which continued till its dissolution by Justinian in A.D. 529. The teaching, by lectures and discussions, included philosophy, mathematics and biology. In 367 Plato went to Syracuse with the object of realising a 'philosopher state' under Dionysios; when this failed he returned to Athens about 360.

Plato, like Demokritos, is said to have visited Egypt and conversed with the priests of Heliopolis.[6] One modern view[7] is that he was in Egypt in 398–5 B.C.,

[1] Scoon, 108 f.
[2] Burnet, (2), 126–92; C. Ritter, *Sokrates*, Tübingen, 1931; Robin, 1928, 148.
[3] Plato, *Phaido*, 97*d*–100. [4] Cornford, CAH, vi, 302; Scoon, 151 f.
[5] D. R. Dudley, *A History of Gynicism*, 1937.
[6] Brandis, DBM, iii, 393; Burnet, (2), 210; Hopfner, *Beih. a. O.*, 1926, iv, 15; Mallet, 125; E. Meyer, (1), II, ii, 41; Zeller, (1), II, i, 404.
[7] K. Svoboda, *Archiv Orientální*, Prag, 1952, xx, 28.

another[1] that he was never there. He often mentions Egypt, e.g.[2] that the priests claimed to have written records 8000 years old, and in his account of Atlantis[3] he professed to have used Egyptian records transcribed by Solon, a copy of which he received from his grandfather. Plato's pupil Eudoxos studied astronomy in Egypt in 381/0 B.C. and had a school in Athens in 368 B.C.[4]

Works

Thirty-six works of Plato have been transmitted as genuine, the *Letters* (some at least of which are spurious) being included. The *Dialogues* are complete and the texts generally good. All the manuscripts go back to a single ancient one, including some spurious works.[5]

The dialogues, arranged below in approximate order of composition, are referred to in the text by the letters preceding the names. V and W are regarded as spurious, T is doubtful:

A.	Charmides	D.	Meno
B.	Ion[6]	E.	Lysis
C.	Gorgias	F.	Euthydemos

[1] Leisegang, PW, 1950, xl, 2342.

[2] *Timaios*, 23D. [3] *Kritias*, 108*d*.

[4] On Plato: Baeumker, 110–209; Brandis, DBM, iii, 392; Brunet and Mieli, 205–350; Burnet, (2), 205–350; Burtt; Cornford, (1)–(6); Deussen, (1), II, i, 215; Festugière, (1), ii, 92; *id.*, *Rev. Philol.*, 1947, xxi, 5–45 (Platon et l'Orient); G. C. Field, *Plato and his Contemporaries*, 1930; A. Fouillée, *La Philosophie de Platon. Exposition historique et critique de la Théorie des Idées*, 2 ed., 4 vols., Paris, 1888–9; Frank; P. Friedländer, *Platon*, 2 vols., Berlin, 1928–30; P. Frutiger, *Les Mythes de Platon*, 1930; Gilbert, 1907, 153–76; G. Grote, *Plato and other Companions of Sokrates*, 3 vols., 1865, 2 ed. 1867; Index, 1870; Hoefer, NBG, 1862, xl, 423; H. Jackson, Plato's later Theory of Ideas, in *J. of Philology*, 1882, x, 132, 253; 1882, xi, 287; 1885, xiii, 1, 242; 1885, xiv, 173; 1886, xv, 280 (crit. by Zeller, (1), II, i, 661, 703); Leisegang, PW, 1950, xl, 2342–2537 (Platon); Lippmann, *J. prakt. Chem.*, 1907, lxxvi, 513–44; *id.*, (1), ii, 28–63; R. C. Lodge, *The Philosophy of Plato*, 1956; A. Mansion, *Introduction à la Physique Aristotélicienne*, Louvain and Paris, 1946, 84 f.; T. H. Martin, *Etudes*, 2 vols., 1841; C. Mugler, *La Physique de Platon*, 1960; P. Natorp, *Platon's Ideenlehre*, Leipzig, 1903; W. Pater, *Plato and Platonism*, 1934; C. Ritter, *Platon, sein Leben, seine Schriften, seine Lehre*, 2 vols., Munich, 1910–23; L. Robin, (1), 174–236; *id.*, *La Théorie platonicienne des idées et des nombres d'après Aristote*, 1908 (pp. 700); *id.*, *Platon*, Paris, 1938; R. Robinson, *Plato's Earlier Dialectic*, New York, 1941, 2 ed. Oxford, 1953; W. D. Ross, (2), (5); Sachs, 1917; Sagnard, (1), 1947, 337; P. Shorey, *What Plato Said*, Chicago, 1933 (bibl.); J. Stenzel, *Zahl und Gestalt bei Platon und Aristoteles*, 2 ed., Leipzig, 1933; J. A. Stewart, (1); T. B. Strong, *Platonism*, 1895; A. E. Taylor, (1)–(3); Ueberweg, (1), i, 178, 183–341; U. von Wilamowitz-Moellendorff, *Platon*, 2 vols., Berlin, 1919; Windelband, (1), 102; A. D. Winspear, *The Genesis of Plato's Thought*, New York, 1940; Zeller, (1), 1889, II, i, 389–982.

[5] Texts. MSS. and older eds. in Fabricius, (1) (*b*), iii, 123. *Greek* (sometimes with Latin. trs.): *Opera*, ed. Bekker, 10 vols., Berlin, 1816–23; 9 vols., London, 1826 (text only); ed. Ast, 11 vols., Leipzig, 1819–32; ed. with notes, G. Stallbaum, 12 vols., Leipzig, 1821–25; 10 vols., Gotha and Erfurt, 1833–60; ed. Hermann, Teubner, 6 vols., Leipzig, 1851–3; ed. Burnet, Oxford, 6 vols., 1900–7.

English trs.: *The Works of Plato* by Thomas Taylor, 5 vols., 4°, London, 1804; by H. Cary, H. Davis, and G. Burges, Bohn, 6 vols., 1852 f.; B. Jowett, *The Dialogues of Plato*, Oxford, 3 vols., 1871, 5 vols., 1892, 4 ed. revised by Allan and Dale, 4 vols., 1953; some separate works.

German trs.: *Sämmtliche Werke, Griechisch und Deutsch*, 26 pts., Leipzig, 1841–81 (*Timaios*, 1856, xv); *Werke*, tr. Schleiermacher, 3 pts., 6 vols., Berlin 1817–28; *Sämmtliche Werke*, tr. Müller and Steinhart, 9 vols., Leipzig, 1853–73.

French trs.: *Oeuvres*, tr. V. Cousin, 13 vols., 1822–40; ed. and tr. Croiset, Robin, Souillet, etc., 13 vols. (I–XIII, iii) in 20, Coll. Budé, 1925–30. The works were first publ. in Latin tr. by Ficino, Florence, 1482; first Greek text, Venice, 1513. They are cited by the page in the ed. of Estienne (Stephanus), 3 vols., Paris, 1578. Works known only in Latin are being edited as *Plato Latinus* (Oxford, 1940 f.), in Arabic as *Plato Arabus* (Oxford, 1943 f.).

[6] Zeller, II, i³, 480, thought *Ion* was perhaps apocryphal, but it is now usually recognised as genuine.

G. Kratylos
H. Banquet (*c.* 384 B.C.)
J. Phaido
K. Republic
L. Parmenides (*c.* 370 B.C.)
M. Thaitetos (*c.* 368 B.C.)
N. Phaidros
O. Sophist (360 B.C. or later)
P. Statesman (360 B.C. or later)
Q. Timaios (360 B.C. or later)
R. Kritias
S. Laws (*c.* 350 B.C.)[1]
T. Epinomis
V. Hipparchos
W. Alkibiades I

The Dialogues do not give a true picture of contemporary scientific knowledge;[2] the suggestion that they are deliberately archaic[3] is improbable. Although greatly interested in mathematics, Plato was not a mathematician. Much of what he attributes to Sokrates may be his own opinions. His one-sided treatment of Herakleitos may have been derived from Plato's teacher Kratylos. He never mentions Demokritos, who may have influenced his later dialogues.[4]

Plato's Philosophy

Plato is the first extant author to give a synthesis of earlier Greek philosophy combined with his own ideas. He drew on four main sources: (1) Orphic and Pythagorean, (2) Parmenides (reality is eternal and change is illusory), (3) Herakleitos (nothing in the sensible world is permanent), (4) Sokrates (ethical and teleological, i.e. the world was created so as to best serve the purpose of man; the real is 'the good'). His views changed with time and his philosophy contains inconsistent elements.[5] According to Plato, there can be no true knowledge (ἐπιστήμη) of the outer world, but only perception (αἴσθησις) and opinion (δόξα). The object of real knowledge must be sought in an incorporeal world existing along with the world of perception, an immaterial (ἀσωματον) Being (τὸ ὄν, οὐσία), the particular manifestations of which belong to the world of Becoming (γένεσις). The discussion of the threefold meaning of 'entity' appears first in the *Sophist* but is developed in the *Republic*:[6] (i) that which is (τὸ ὄν), (ii) that which is not but still real (τὸ μὴ ὄν), (iii) that which truly is (τὸ ὄντος ὄν). What is truly real is the idea (ἡ ἰδεα), form (τὸ εἶδος), essence or being (ἓν or ὄντως ὄν), *henad* (ἑνάδ), or monad (μονάδ).[7] There are ideas of everything (some he later abandoned), forming a real world, arranged in order of quality or goodness, the highest being the Idea of the Good, sometimes identified with God.

The ideas exist in an independent, real, unchanging, eternal world, a supracelestial place (ὑπερουράνιος τόπος). The material atoms (μόρια) which form the elements are not (as Demokritos supposed) the real causes but only co-causes (συναίτια) in world creation, and natural law (ἀνάγκη) is not the sole moving force but is only an instrument of the creative divine mind. Knowledge of ideas is obtained by recollection (ἀναμνησις); the soul 'be-

[1] Said to have been revised by Philip of Opos; Zeller, II, i^3, 555.
[2] Frank, 1923, 65 f.; against Cornford, CAH, vi, 330.
[3] Taylor, (1), 11, 18, 371, 395, 410, 429, 448, 467, 472, 587, 608, 619.
[4] Frank, 55, 120; T. H. Martin, ii, 42, 390; Ruska, *Isis*, 1924, vi, 48; A. E. Taylor, (1), 3.
[5] Burnet, (2), 155, 256, 281, 315; Deussen, (1), II, i, 250 f., 269; Gilbert, 153; Ueberweg, (1), i, 329; Zeller, (1), II, i, 105, 562, 617, 643, 710.
[6] Jowett, 1892, iv, 283; Merz, 1902, iii, 434; *Works*, iii, 143.
[7] Zeller, (1), II, i, 658.

thinks itself' of knowledge it previously had in the world of incorporeal reality before it was imprisoned on earth in the body (an Orphic idea); perception of similar corporeal things calls up a philosophic impulse (ἔρος) by which the soul is gradually raised to knowledge of true reality. The ideas are not merely 'in' the mind but exist as real objects apprehended by the mind. Objects perceived by the senses act on the mind by perception and occupy a place between 'being' and 'not being'; they 'copy' or 'partake in' the real forms or ideas, as an actual bed does of an ideal one.[1]

Modern commentators disagree on the meaning of Plato's theory of ideas; it is said that Aristotle did not understand it, and that Plato meant something different from what he said.[2] Antiphon the Sophist (Athens, *c.* 425 B.C.), a mathematician, interpreter of dreams, and a natural philosopher on Ionian lines, said the real nature of a wooden bed is its material, not its form; if you bury a bed and the rotting timber conceived the power of growth, what would come up would be a tree, not a bed.[3]

Plato calls the written word a 'pleasant game (παγκάλη παιδιά)',[4] or 'sober amusement',[5] and laid more stress on verbal discussion, although some things are 'impossible to speak of before a crowd (εἰς πάντας)';[6] and when he felt unable to express an idea in ordinary language he resorted to myths.[7] All this makes it difficult to say what Plato meant.[8] Over this treacherous surface, we shall move rapidly and warily.

The Timaios

The most important work of Plato from our point of view is the *Timaios* (*Timaeus*), perhaps written about 360 B.C. after his visit to the Pythagoreans in S. Italy, including Archytas of Tarentum. There was a persistent tradition that it was composed from three small Pythagorean books bought at a high price from Philolaos. The main speaker in the dialogue is Timaios the Pythagorean.[9] A partial translation into Latin by Chalcidius (*c.* A.D. 325) was the only dialogue read in the Middle Ages, the others first appearing at the end of the 12 cent.[10]

Although described as 'playful humour'[11] the *Timaios* is really a serious attempt to deal with difficult problems.[12] Plato emphasises the uncertainty of his treatment but claims general accuracy; the attempt to base chemical and physiological phenomena on mathematical relations was a failure, but the book

[1] Ross, (2), 157; A. E. Taylor, (1), 60, 90 f.; (2), 34, 41; (3), 186 f.; Scoon, 168; Zeller, (1), II, i, 609.
[2] Inge, 1929, 8, 74.
[3] Aristotle, *Phys.*, ii, 1, 193*a*; Freeman, (1), 1949, 391; (2), 144–53.
[4] N, 276*e*; Zeller, (1), II, i, 572. [5] Q, 59D. [6] Q, 28C.
[7] AH, 37, 47, 113, 215; Robin, 222; Zeller, (1), II, i, 478, 484, 579.
[8] Inge, 1929, 8, 74.
[9] Burnet, (1), 279; (2), 339; Cornford, CAH, vi, 311; Frank, 58, 72, 260; A. E. Taylor, (1), 9; Ueberweg, (1), i, 222, 240, 307. Translations, with notes: Archer-Hind (here denoted by AH); A. F. Lindau (Latin tr.), Leipzig, 1828; Plato, *Opera*, ed. Stallbaum, Gotha and Erfurt, 1838, vii; T. H. Martin (here denoted by TM); Rivaud, French tr., 1925; A. E. Taylor, (1); see Leisegang, PW, xl, 2505.
[10] R. Klibansky, *The Continuity of the Platonic Tradition during the Middle Ages*, Oxford, 1939; Stewart, (1), 210; Ueberweg, (1), i, 649.
[11] Cornford, (2), 163; A. E. Taylor, (1), 241, 314, 444; Zeller, (1), II, i, 671, 777, 790, 800.
[12] Festugière, (1), 1949, ii, 94; Frank, 65 f., 88, 95; Freeman, (1), 1949, 223; Reitzenstein, 7), 145; B. Russell, 170.

is perhaps the first extant treatise on chemistry (Demokritos did not apply the atomic theory to this); he says: 'on these subjects we must be satisfied with a likely story, and demand no more.'[1]

Plato was not an experimenter like Demokritos, but he is said to have invented a water alarm-clock,[2] and it is unfair to say[3] that he was 'disdainful' of science. He respected the experts and tried to extract information from them which he did not always understand. He mistrusted knowledge gained by observation and experiment alone; he says 'if we try to test the theory of colours by experimental examination (ἔργῳ σκοπούμενος) of what occurs on mixing them, we shall misconceive the difference between the human and divine natures (ἀνθρωπίνης καὶ θείας φύσεως)',[4] and if he means pigments as contrasted with coloured lights he is right.

The *Timaios* gives two separate accounts of the origin of the universe.[5] In both, a divine artificer, the Demiourgos (δημιουργός), plays a leading part. He is a definite being,[6] not a myth or one aspect of the world-soul. This creator 'outside' introduces 'a chaos of wild disorder' into Plato's philosophy.[7] Since the cosmos, an image of an ideal, is to be as perfect as possible, Plato provided it with a soul, the World-Soul (an idea he first introduced), 'a great animal' or living being (ζῷον).

In the first account,[8] perhaps his own, the four elements are already in existence.[9] In an earlier dialogue[10] he says one philosopher had three entities, another [Archelaos] two, moist and dry or hot and cold, but the Eleatics, derived from Xenophanes and others before him, say that 'the all' is only one. The Ionian [Herakleitos] and later some Sicilian muses [Empedokles] 'thought it safer to connect all these and say that entity is both many and one, held together by strife and love. But whether any one of these illustrious and ancient men has spoken the truth it is difficult to say'.

The Demiourgos takes fire and earth, to join which force is necessary, and an intermediary is required. Since 'solids can never be united by one mean but require two', air and water were added so that 'fire is to air as air to water, and air to water as water to earth'; fire : air = air : water = water : earth. In this mathematical proportion, 'out of four things of this kind (ἐκ τε δὴ τούτων τοιούτων), the body of the universe was created' in the form of a smooth sphere, and all the four elements were used ~~up~~.[11] This was Plato's excursion into Physics.[12]

[1] Q, 29, 59, 68, 72; Farrington, (1), 81 f.; Gilbert, 156; Jowett, 1871, ii, 470; TM, i, 25, 195; Whewell, (1), i, 348.

[2] Athenaios, iv, 75; Diels, (3), 1924, 198. [3] Zeller, II, i, 791. [4] Q, 68D.

[5] There is no Greek word for 'creation'; Plato uses γένεσις (origin) or πῆξις (putting together), Aristotle κοσμοποιία (making the universe).

[6] Ross, (2), 127, 161; Zeller, II, i, 792. [7] AH, 37, 40. [8] Q, 30–48.

[9] Cornford's idea, (6), 178, that they are 'qualities' (as in Herakleitos) rather than 'bodies' (as in Empedokles) is refuted by Plato's own words.

[10] O, 242*d*.

[11] Q, 32; the proportion, fire : air = air : water = water = earth, first appeared in C, 507*e*–508, where Plato says geometrical equality (ἡ ἰσότης ἡ γεωμετρική) has great power (μέγα δύναται) among gods and men. This, and the statement: 'if the first and last become the mean and *vice versa* all is one' (Q, 32A), are Pythagorean: Gomperz, (1), ii, 329, 482, 568.

[12] Aristotle, *Metaphys.*, *A* (i), 6; Vetter, *Isis*, 1929, xii, 349.

The World-Soul was then created from (i) an undivided substance, the Same; (ii) a substance which in material bodies is divided, the Other; and (iii) the Form of Being (οὐσίας εἶδος). These are forcibly mixed in a bowl (κρατήρ), and the mixture manipulated in obscure numerical ways and distributed in and over the universe. The less perfect dregs were scraped out of the bowl to make the star-gods.[1] By welding together portions of the four elements, as by invisible rivets (ἀοράτοις γόμφοις), the star-gods then made human bodies and provided each with a soul.[2]

Plato now begins 'all over again' with another account, which is 'unusual but even more probable' than the first.[3] In place of the four elements, the 'first' is now an amorphous being (φύσις), which is perhaps just 'space' or 'chaos'. It corresponds roughly with Aristotle's primary matter (ὕλη, *hule*), but Plato had no idea of this, and in the only place where ὕλη is used in this sense[4] it is still a metaphor for 'wood' or 'timber' (see p. 80). It is a receptacle (ὑποδοχή), formless stuff, mother or nurse, dough (ἐκμαγεῖον), place (τόπος), all receiving (πανδεχές), that thing (ἐκεῖνο), or, best of all, space (χώρα). (Plato first used χώρα for space in general.) It is 'not-being (μὴ ὄν)' but is real; it is shapeless and invisible, but acts like a dark shadow, not a body (σῶμα) but with enough strength to stand between us and the Ideas and conceal them from us. It passes from the state of non-being to corporeality by taking on the forms of the four elements (στοιχεῖα, *stoicheia*).[5] The name στοιχεῖον (*stoicheion*) for 'element' was first used by Plato.[6] Its original meaning was perhaps shape (μορφή) or idea (ἰδέα), and it was taken over from the Pythagoreans, perhaps Philolaos;[7] from Demokritos[8] is doubtful.[9]

The literal meaning of στοιχεῖα is a row of letters, the alphabet,[10] the Latin *elementum*, first used by Lucretius[11] and perhaps *l-m-n-tum*, or[12] from ἐλέφας, *elephantum*, ivory tablets with letters used in schools. Vitruvius does not use it, Seneca infrequently, but Christian authors frequently.[13]

Plato assumed that the forms of the four elements were cut out of space by two kinds of plane right-angled triangles (τρίγωνα), so small as to be invisible

[1] Q, 35.

[2] Q, 41–2; A. J. Kilb, *Platons Lehre von der Materie*, Dissert. Marburg, 1887, 41 f., thought 'matter' as something undergoing chemical changes first occurs in the *Timaios* only as a popular belief, since 'matter' is not a concept in Plato's philosophical system. For the Neoplatonists and Gnostics matter was evil, and hence the Demiourgos was an imperfect or even malicious being.

[3] Q, 48–56.

[4] Q, 69A; AH, 255 ('wood prepared for the carpenter'); TM, i, 185, 295 (οἷα τέκτοσιν ἡμῖν ὕλη παράκειται; 'comme des ouvriers, nous nous sommes procuré ... une matière toute préparée').

[5] Baeumker, 110, 132, 152, 163; Deussen, (1), II, i, 267, 269, 273, 275–7, 348; A. E. Taylor, (1), 322, 328, 466, 493; TM, ii, 177, 295; Zeller, (1), II, i, 719, 721, 731–2, 800.

[6] Zeller, (1), I, ii^6, 950.

[7] Burnet, (1), 88, 228.

[8] Frank, 81, 170; Natorp; Sachs, 223.

[9] A. E. Taylor, (1), 306.

[10] Burnet, (1), 228, 230, 336; Diels, (2), 62–8 (not used before the 5 cent. B.C.).

[11] i, 82, 198, 824, etc.; ii, 688 (letters).

[12] Diels, (2), 5, 68, 83.

[13] Diels, (2), 74 f.; O. Lagercrantz, 'Elementum', in *Skrifter utgifna af Kungl. Humanitiska Vetenskaps-Samfundet i Uppsala*, Uppsala and Leipzig, 1906, xi, no. 1 (pp. 109) (BM Ac 1078) suggested that the original was στείχειν (walk, march), or στοιέω, thence στοιχεῖον meant distance, or division. Dornseiff, 14, thought *stoicheion* originally denoted one of the 12 zodiacal signs and had an astrological significance; Alkinoos (Alcinous), 1 cent. A.D. (*Epitome of Platonic Philosophy*; Plato, *Works*, vi, 271) had connected the 12 faces of the dodecahedron with the 12 animals of the zodiac.

— a 'geometrical atomism'.[1] One kind (alpha, α) of triangle, equilateral, is made by cutting up a square into four equal parts (Fig. 1). The other (beta, β), with one side half as long as the hypotenuse, is made by cutting up the 'most beautiful' equilateral triangle into six equal parts. What were later called the

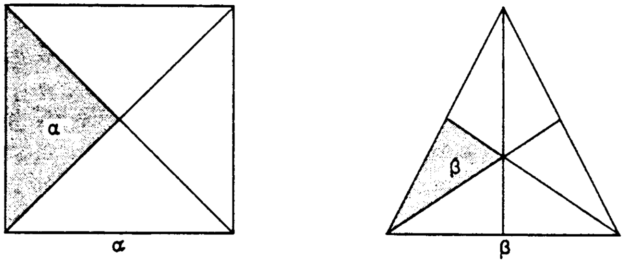


FIG. 1. THE PLATONIC TRIANGLES

four 'Platonic bodies', representing the four elements, Plato constructed from the triangles; from β-triangles the tetrahedron, which is fire, the octahedron, which is air, and the icosahedron, which is water; from α-triangles the hexahedron (cube), which is earth (the α-triangles were used instead of squares, because they are smaller). 'A fifth figure yet alone remained, and God used it for the Universe.' This is not formed from triangles but from regular pentagons and is the dodecahedron. It does not represent an element (e.g. not the ether), but is 'a picture or foundation (διαζωγραφεῖν)' of the whole Universe. The latter, it will be remembered, was at that time thought to be a sphere, but this cannot be constructed from triangles, and Plato seems to have chosen the dodecahedron as the nearest approach to it.[2]

The theory of the five solids and their relations to the elements is said by Aëtios to be Pythagorean; it may have been modified by Plato to explain the transformation of one element into another. Demokritos had given the atoms various shapes at random.[3] Perhaps the Pythagorean *tetraktys* in its triangular form (p. 11) suggested triangles as the boundaries of the elementary bodies.[4] Plato's relations to a musical scale are purely imaginary.[5] Chalcidius (4 cent. A.D.) thought Plato's small particles (ὄγκοι, *onkoi*) were the same as atoms.[6] Hammer Jensen[7] believed that Plato first shows a knowledge of the atomic theory in the *Timaios*, when he had got to know of Demokritos's treatise and felt that he must take account of it.

The ancient tradition, perhaps from Eudemos (*c.* 350–300 B.C.), was that the Pythagoreans knew how to construct and inscribe in a sphere the cube, tetrahedron, and dodecahedron; the problem was solved for the octahedron and icosahedron by Theaitetos in Plato's Academy, and then the five regular solids were called the 'Platonic

[1] Burtt, 30, 58; Cornford, (5), 210 f.; Frank, 22; TM, ii, 234; Zeller, (1), II, i, 802.
[2] Zeller, (1), II, i, 800; Plutarch (*Quaest. Platon.*, v; *Moralia*, ed. Wyttenbach, Oxford, 1800, v, 83) asked why Plato used only figures bounded by straight lines and not circles.
[3] Freeman, (1), 1949, 223.
[4] Burnet, (1), pref. vi, 102, 276 f., 292; Eisler, (1), 766; Frank, 369; Sagnard, (1), 337 f.
[5] Frank, 13 f., 150 f.; Freeman, (1), 1949, 233; (2), 78.
[6] Cudworth, i, 94.
[7] *A. Phil.*, 1910, xxiii, 92, 211; Sachs, 6, 185, 198, 206.

bodies (σχήματα Πλάτωνος)'.[1] The five Platonic bodies are frequently mentioned by Arabic authors; al-Kindī (d. A.D. 873) wrote a treatise on the 'relation of the five figures with the elements'.[2]

There are three views as to what Plato supposed was inside the regular solids. (1) It was simply space (χώρα), perhaps not the same as a vacuum (κενός), which Aristotle[3] expressly says Plato denied, cut up into shapes of the regular solids by *mathematical* triangles, i.e. *bounded* by surfaces.[4] (2) The particles are *composed* of surfaces, the triangles being thin sheets of matter.[5] (3) The bodies have a sort of primary matter (Aristotle's ὕλη) inside them.[6] In an obscure passage[7] Plato says the small bodies (σμικρότερα) of the four elements cannot suffer change by the action of their own kind but, by combat with stronger ones, are divided. The parts tend towards bodies of the same kind, or rather they form bodies similar to those of the stronger body which has conquered them, and by agitation of the medium are carried to the appropriate place (cf. Leukippos, p. 35): διαλυθέντα ἐκφύγῃ πρὸς τὸ ξυγγενές, ἢ νικηθέντα, ἓν ἐκ πολλῶν ὅμοιον τῷ κρατήσαντι γενόμενον. This is Plato's theory of chemical change.

Plato did not regard the four 'elements' as ultimate ones; he says[8] the 'true' elements cannot be known. They are four states of one thing (φύσις), a plastic material (ἐκμαγεῖον), 'clinging to being as best it can'; the things that pass into and out of it (τὰ εἰσιόντα καὶ ἐξιόντα) are copies of the eternal things; bodies are sensible entities occupying portions of space, 'copies' of forms.[9] The things which pass into and out of the receptacle are the 'opposites' characteristic of the four primary bodies, the receptacle having no qualities.[10] Plato first used the name ποιότης for 'opposites', translated *qualitas* by Cicero.[11]

A separate body, such as a piece of gold, is alone a thing with permanent properties; it can be given all kinds of shapes by working, yet 'it would be much the safest thing in view of truth to say that it is gold (εἰπεῖν ὅτι χρυσός); as to the triangles or any other shapes that were impressed on it, it is

[1] Frank, 57 f.; Sachs; A. E. Taylor, (1), 358 f.; Archer-Hind, 12, 47, 93, 157, 161, 167, 188, 201, 205, 215, 239, 248, 251–5, 287 (cf. Leisegang, PW, xl, 2505) thought Pythagorean influence had been exaggerated, the main sources being Herakleitos, Parmenides, and Anaxagoras, with 'a hint' from Demokritos; Filliozat, (1), 199 f., claimed Indian influence.

[2] Kraus, MIE, 1942, xlv, 178.

[3] *De gen. et corr.*, i, 8, 325*b*.

[4] AH, 183, 187; Baeumker, 151–87; A. Boeckh, *Gesammelte kleine Schriften*, Leipzig, 1866, iii, 109–80 (following Aristotle); Frank, (1), 101 f., 324, 369 (incorporeal entities, ἀσώματα εἴδη); Jackson, *J. Philol.*, 1885, xiii, 1 (18) (space impressed with certain regular figures, supplies indeterminate qualities); Robin, 1928, 225; Ross, (4), 120 f.; A. E. Taylor, (1), 312, 321 (corporeality identified with extension, as in Descartes).

[5] Alexander of Aphrodisias (3 cent. A.D.), *Quaestionum Naturalium et Moralium ad Aristoteles Philosophiam illustrandam*, ii, 13, ed. Spengel, Munich, 1842, 107; Frank, 55; T. H. Martin, ii, 234 f., 241; Ueberweg, (1), i, 307, 333; Zeller, (1), II, i, 728 f., 734, 801 f., 804 (q. Aristotle, *De coelo*, iii, 1, 299*a*; *De gen. et corr.*, i, 2, 315*b*; ii, 1, 329*a*).

[6] AH, 203 (relies on Plato, Q, 56B: τὸ μὲν τῆς πυραμίδος στερεὸν γεγονὸς εἶδος, 'the solid body which has taken the form of the pyramid' (of fire); but στερεός was applied also to numbers (στερεός ἀριθμός, cubic number) and 'solid' does not seem necessary); Burtt, 304 ('fulfilled much the same function as the Aristotelian matter'); Cornford, (5), 182 f., 204 f.; Gilbert, 159 f.; Gomperz, (1), ii, 486, 606; Ross, (2), I, cii; M. Sartorius, Die Realität der Materie bei Platon, in *Philosoph. Monatsh.*, 1886, xxii, 129–67.

[7] Q, 57; cf. 62–3.

[8] M, 202*a*.

[9] Frank, 1923, 101 f., 115, 289, 324, 369; Ross, (2), I, cii; (4), 120 f., 222.

[10] Cornford, (5), 1937, 182 f., 204 f., 229 f.

[11] Zeller, (1), III, i³, 604.

safest never to speak of them as existing (μηδέποτε λέγειν ταῦτα ὡς ὄντα)'.[1] The statement is metaphorical;[2] gold, like the odourless oil used to make perfumes,[3] is an analogy for the 'plastic mass (ἐκμαγεῖον)' which can receive all forms; visible and tangible 'secondary matter' is a real body but it is never identified with the 'primary matter'.

Plato admitted that the concept of 'formless nature (ἄμορφον εἶδος)' taking on 'forms' is 'most bewildering and hard to comprehend'.[4] It has been said that he regarded matter as that *in which* (ἐν ᾧ) sensible things appear, whilst Aristotle considered it as that *from which* (ἐξ οὗ) they are made,[5] whilst Archer-Hind[6] says Aristotle's ὕλη is 'taken bodily from Plato'. Plato supposed that it existed before the creation of the universe, before time was created, but since this contradicts the whole of his philosophical system it has been supposed[7] that the description is an old myth of chaos. It seems doubtful if Plato intended any definite meaning to be extracted from his words.

Aristotle[8] attributes to Plato a theory not found in his writings and perhaps given orally. He says Plato postulated two elements (στοιχεῖα) present in the ideas and all existing things: (i) a form-giving power (πέρας), and (ii) a form-receiving, in itself formless (ἄπειρον) one, which the Pythagoreans had opposed to the finite (πεπερασμένον), but Plato divided into two, an indefinite dyad (ἀόριστος δυάς) of the great and small. The latter, with the active One (ἕν), produced in a natural manner (εὐφυῶς) the ideal numbers, among which was a relation of succession, but they could not be added. H. Hancock[9] saw a relation with the 'ideal numbers' of E. E. Kummer, which the latter[10] thought symbolised chemical elements and compounds.

The triangles may be separated again and built up into new forms so that one element may pass into another. The idea of the transmutation of matter follows naturally and alchemy in germ goes back to Plato.[11]

Plato[12] first used κίνησις (*kinesis*, motion) to denote qualitative change (ἀλλοίωσις, μεταβολή) as well as motion. When one part of water is transformed it gives two parts of air and one of fire, one part of air gives two parts of fire, and these changes are reversible. The number of equilateral triangles remains constant: water $=20$, air $=8$, fire $=4$; hence 1 water $(20)=1$ fire (4) $+2$ air (2×8); and $2\frac{1}{2}$ air $(2\frac{1}{2}\times 8)=1$ water (20). The cubical particles of earth when resolved give squares (not triangles), which 'drift about'; hence earth is not transformable into other elements. Even if it were resolved into triangles, these (α-triangles) would be different from those (β-triangles) of the other elements.

The different properties of bodies depend on: (i) the different sizes of the

1 Q, 50a; AH, 174 f.; TM, i, 135 (la réponse le pure sûrement vraie serait que c'est de l'or).
2 Baeumker, 159 f. 3 Q, 50E. 4 Q, 51B.
5 Baeumker, 166; De Wulf, 1909, 21. 6 AH, 183.
7 Cardinal Bessarion; Baeumker, 143 f., 151, 177 f., 184, 187.
8 *Metaphys.*, i, 6; A. E. Taylor, (1), 28, 77, 111, 324; Baeumker, 196; Leisegang, PW, 1950 xl, 2342; Ross, (2), ii, 434; *id.* (5), 142, 154, 222, 233; Zeller, (1), II, i, 679, 946.
9 *American Mathematical Monthly*, 1928, xxxv, 282–90; Taylor, (1), 687.
10 Crelle's *Journal für Mathematik*, 1847, xxxv, 327–67 (359).
11 Cornford, (5), 1937, 224; Ehrenfeld, in Diergart, 67.
12 L, 162*c*–163*d*; M, 178*e*–184*b*; Q, 56D; AH, 205; Cornford, (5), 224; Inge, (1), 1918, ii, 65; Rivaud, ed. Q, introd.; A. E. Taylor, (1), 383; Zeller, (1), II, i, 802.

triangles, (ii) the different mixture-ratios of the elements, and (iii) the different combinations of opposites (hot and cold, moist and dry). Particles of the same element may have different sizes, but the smallest particle of air is always greater than the largest particle of fire. Particles of an element in contact only with similar ones remain unchanged, but small particles enclosed in larger ones are broken up, and their constituents must either pass into the stronger element or find a place for themselves.[1]

Plato did not think, with Demokritos, that the particles move spontaneously but that the whole universe is subject to a pressure inwards (*sic*), due to its revolution, so that everything is packed as tightly as possible.[2] In breaking up, the particles are all changing their places and those which have changed their nature are sent to 'the place proper to the element to which they are assimilated (πρὸς τὸν ἐκείνων ἂν ὁμοιωθῇ τόπον)'.[3] Plato 'affirms in almost so many words, that nature avoids a vacuum. Wherever there is a void the elements are pushing and thrusting one another until equality is restored'.[4] He used the principle of 'circulation (περίωσις)' or abhorrence of a vacuum to explain many phenomena.[5]

Plato[6] emphasised that in space there is no up and down (ἄνω καὶ κάτω). If we lift a body on the earth into the air region it tends to cling to the earth, its own kind, and seems heavy. A small mass is more easily moved into the alien element and seems light. But if we could go into the fire region with a balance and put some fire in it, and then forcibly raise the balance (ἐπαναβὰς ἐπ' εκεῖνο δύναμιν) into the air region, the fire would tend to unite with the large mass of fire and seem heavy, whereas on the earth fire is tending to its proper place above and seems light.

Plato, following Thales, seems to have assumed that water is the primary substance. There are two primary divisions of water; (i) the liquid and (ii) the fusible kind (τὸ ὑγρόν τὸ δὲ χυτὸν), the first having small watery particles of different sizes easily moved, the second larger, heavier, and uniform particles. Fire easily penetrates and 'dissolves' (melts) bodies because of the cutting action of the sharp points of its tetrahedral particles.[7] When the fire particles go out, air particles take their place, compress the fluid mass, and cause solidification, the fluid particles recovering their former places.[8]

In the constant dissolution and regrouping as particles of the elements, the triangles become worn and the particles formed from them (Descartes' 'old worn particles', Vol. II, 432) are less fitted to link together to form bodies; this is the cause of old age and death of an animal, the young having triangles 'fresh from the workshop.'[9] The atoms of Demokritos, on the contrary, were infinitely hard and never became worn (see p. 41).

Fire, composed of finer particles than any other element, penetrates through

[1] AH, 207; Cornford, (5), 230 f.; Zeller, (1), II, i, 804.
[2] Q, 58A; AH, 209.
[3] Q, 57C; AH, 207; Cousin, Plato, *Oeuvres*, xii, 168 f.; TM, i, 155; ii, 253: 'occupied by the bodies of which they have taken the resemblance.'
[4] Q, 80C; Jowett, 1871, ii, 529*.
[5] AH, 294, 298.
[6] Q, 62E–63C; AH, 231; Cornford, (5), 262; Partington and McKie, *Ann. Sci.*, 1937, ii, 361; TM, ii, 272–80.
[7] Q, 58B–E.
[8] Q, 59A.
[9] Q, 81.

water, earth, and air, and nothing can keep it out.[1] The sharp, pricking, and lacerating particles of fire produce the sensation of heat,[2] and the red colour of the blood is due to its fire content.[3] Moisture produces cold. There are many kinds of fire, such as flame and the effluence from flame (ἀπὸ τῆς φλογὸς ἀπιόν), which does not burn but gives light to the eyes, and that kind (the red glow) which remains in the embers when the flame is out.[4]

Metals are classed as 'fusible kinds of water (χυτά ὕδατα)'; the densest, formed of the finest and most uniform particles which filtered through rocks and congealed, is gold.[5] Plato[6] says: 'if we knew how to make the rocks of gold'; all metals are water, and transformation of one into another is possible. This idea led later to alchemical theories of the growth of metals in the earth, and their ripening or perfection under the influence of emanations from the planets, etc., and the Stoic *pneuma* became the 'soul' of metals, or 'mercury'.[7]

In his works Plato mentions gold, silver, bronze, brass, tin, lead, iron, and steel. The meaning of what he calls χρυσοῦ δὲ ὄζος[8] is doubtful; ὄζος means branch, 'eye' from which a branch springs, or offshoot (scion). It has been translated 'node of gold' (Davis, Martin, Rossbach), 'scion of gold' (Cornford), and 'offspring of gold' (Archer-Hind). Plato says it is very hard owing to its density and is called *adamas* (ἀδάμας). It has been identified with hæmatite (W. J. Lewis in Archer-Hind), diamond (Cornford, Cousin, Martin, Rossbach, Schrader), steel (see below), or an alloy of gold and copper (Schneider, in Martin).[9] Plato does not definitely mention diamond; ἀδάμας elsewhere[10] means steel. The meaning 'diamond' perhaps first occurs in Theophrastos[11] and is in Pliny,[12] who also speaks of *auri nodi*.

A kind of metal with particles like those of gold but of more than one kind, with a small admixture of fine earth (γῆς λεπτὸν), is shining bronze or copper (χαλκός). It is more compact (πυκνότερον) than gold but lighter (κουφότερον) because it has large pores. After a long time the admixture of earth begins to separate [and works its way out] to the surface, and is called verdigris (ἰός, literally 'rust'). The other metals, Plato says, could easily be explained by the same kind of 'recreation (παιδία)'.[13]

Earth which is obtained through water, and compressed by the air formed from water, produces stones, which are not dissolved by water.[14] The transparent stone (πέτρα διαφανὴς) formed from equal and uniform particles[15] is rock crystal. The 'crystal' (κρύσταλλος),[16] in a passage on the form assumed by water on cooling, is ice. Simler (1574) still thought that Alpine rock crystal was formed by intense frost from ice.[17] When the moisture is driven off by fire,

[1] Q, 78A. [2] Q, 61E. [3] Q, 80E.
[4] Q, 58D; AH, 211. [5] Q, 59B. [6] F, 289*a*.
[7] Cornford, (5), 252; Ehrenfeld, in Diergart, (1), 67. [8] Q, 59B.
[9] AH; Blümner, iii, 228 (no special Greek name for gem; λίθος used); Cornford, (5), 251 (Plato had never seen diamond but thought it was a metal); Cousin, *Oeuvres*, xii, 170; Davis, Plato's *Works*, ii, 368; Krause, 10; LSJ, 20; Rossbach, PW, vii, 1052 (gems 'sprouted' from minerals and common stones, diamond from gold); Schrader, (1), 151; A. E. Taylor, (1), 416 (*auri nodus*); TM, i, 159; ii, 259.
[10] P, 303*d*; *Works*, iii, 266 (in a sentence on the fusion of metals); K, x, 14, 618*c* (ἐξ ἀδάμαντος).
[11] *On Stones*, § 19. [12] xxxvii, 15.
[13] Q, 59C–D; A. E. Taylor, (1), 417. [14] Q, 60B–C; AH, 218; TM, ii, 263.
[15] Q, 60B. [16] Q, 59D; AH, 217. [17] Freshfield, *Isis*, 1924, vi, 65.

potter's clay (κέραμος) results; when some water is left, and the earth is liquefied by fire, it forms on cooling a black stone (τὸ μέλαν χρωμα ἔχων λίθος), perhaps basalt.[1] When most of the water is driven off, two kinds of things are formed, containing fine particles of earth and saline particles: (i) a semi-solid body soluble anew in water, which purifies from oil and dirt and is soda (λίτρον);[2] and (ii) that which easily blends with all kinds of tastes on the palate, viz. salt (ἅλς).[3] Another kind of alkali is χαλαστραῖον (*chalastraion*), used by dyers of purple to clean their wool,[4] together with lessive (κονία) and 'soaps' (ῥύμματα) (true soap was unknown in Plato's time.

Bodies composed of earth and water combined are not dissolved (οὐ λυτά) by water but only by fire, since only fire particles are small enough to penetrate the pores.[5] Those compounds which have less water than earth are all kinds of glass and fusible stones (περὶ τὴν ὕαλον γένος ἅπαν ὅσα τε λίθων χυτὰ εἴδη); those containing more water include bodies like wax and incense (κηροειδῆ καὶ θυμιατικὰ σώματα).[6]

Most kinds of water when mixed together and filtered from the earth through plants form saps or juices (χυμοί); many have not been given special names, but those of a fiery kind, and better known than the others, are: (i) wine, which heats the soul and the body; (ii) the brilliant oily species called pitch (πίττα), castor oil (κίκι), and common oil (olive oil); (iii) that which expands the contracted pores of the mouth to their natural state, producing a sweet taste, viz. honey (μέλι); (iv) that scummy juice, different from the rest, which consumes flesh by burning (τῆς σαρκὸς διαλυτικὸν τῷ καίειν) is called ὀπός, *opos*.[7] It is perhaps the milky acrid juice of some *euphorbia*.[8] A narcotic drug is mandragora (μανδραγόρας),[9] the mandrake.[10] The unnamed poison given to Sokrates,[11] is usually supposed to be hemlock (κώνειον), for which wine is said to be an antidote,[12] although its action does not correspond with that of the alkaloid coniine.[13] Hellebore (ἐλλέβορος)[14] had been mentioned by Hippokrates (see p. 27).

God created four kinds of animated beings[15] related to the four elements: (i) the celestial gods, almost wholly composed of fire, (ii) winged beings inhabiting the air, (iii) beings which live in water, (iv) animals which walk on the earth. Animals are degenerations of man by rebirths, the first lower stage being women,[16] but plants were not so formed but always existed as such. Yet

1 Lindau, *Timaeus*, 1828, 95; AH, 220; TM, ii, 264.
2 Q, 60D; AH, 221; TM, i, 163; ii, 264; Lindau, 95.
3 AH, 221, and TM, ii, 268, for notes.
4 K, iv, 8, 430*a*; *Works*, ii, 114; Pliny, xxxi, 46, *chalastricum*, a kind of soda (*nitrum*) formed white and pure like salt from a lake near Chalastra in Macedonia.
5 Q, 60E–61B; AH, 222–3.
6 Q, 61B–C; TM, i, 165; ii, 261; no distinction is made between inorganic and organic bodies; wax is only a 'watery' glass.
7 Q, 60B; AH, 218 (verjuice); Cousin, xii, 175; Davis, *Works*, ii, 369; TM, i, 163; ii, 262; all give 'opium'; Cousin gave ἐκ ἀφορισθὲν τοῦ χυμῶν as 'secreted from' instead of 'different from', which Archer-Hind (q. T. Taylor) accepts.
8 A. E. Taylor, (1), 422, suggested fig-tree juice, which Homer and Aristotle, *De gen. animal.*, i, 20, 729*a*, said curdles milk.
9 K, vi, 4, 488*c*; *Works*, ii, 174.
10 Lippmann, (1), i, 190; ii, 40.
11 J, 115*a*; *Works*, i, 125.
12 E, 219*e*; *Works*, i, 503.
13 Lippmann, (1), ii, 40.
14 F, 299*a*.
15 Q, 39–40, 91–2.
16 Q, 76E.

plants, partaking of life, may also be called animals, differing from them only in being rooted and stationary;[1] they have feeling (αἴσθησις) (Aristotle denied this). Plato distinguished three kinds of soul (ψυχή), regarded as separate:[2] (i) the immortal intelligent (λογιστικόν) part (νοῦς) in the brain; and two mortal parts, (ii) a courageous (θυμοειδές) in the breast, and (iii) an appetitive (ἐπιθυμητικόν) below the diaphragm.[3] He very vaguely relates these to plants, animals, and man.[4] The highest part of the soul, imprisoned in the body as in a tomb, 'according to the followers of Orpheus',[5] would at best pass back on death to the star whence it came, but usually passed to animals. It resides in the highest part of the body (the brain),[6] which is its 'natural' place.[7]

Here and elsewhere Plato uses the principle that 'like assorts with like' Elsewhere[8] however he mentions a Sophist who said that 'like is hostile to like', and[9] dry desires moist; cold, heat; bitter, sweet; sharp, blunt; 'contrary is food for contrary' and 'things love unlikes', and:[10] τοῦ ὁμοίου γ' <ὅτι> τὸ ὅμοιον φίλον γίγνεται; τὸ δὲ ἀνόμοιον ἀνομοίων ἐπιθυμεῖ καὶ ἐρᾷ (things long for and love unlikes). He speaks (perhaps from Archelaos) of the 'strife and marriage of the elements',[11] and reports a myth (Orphic ?) of male and female first united in a sphere, then separated into the two sexes, which tend to reunite.[12] Perhaps[13] Plato thought that the active power (δύναμις τοῦ ποιεῖν) of an element acts only on unlikes; heat modifies cold, etc., and when the upward or downward transformation is complete change ceases. Water mingled with fire becomes vapour (λεπτόν ὑγρόν); when deprived of fire in the air it is congealed above the earth to hail, half-congealed to snow, and congealed on the earth to hoar-frost.[14]

Some of Plato's medical theories,[15] based on the four humours (see p. 29), may be derived from Philistion of Lokroi, a follower of Empedokles. Plato made no distinction between veins and arteries.[16] Galen was wrong in saying that Plato made the heart the cause of arterial and the liver that of venous circulation. The fundamental structure in the body is the spinal marrow. It is the seed (σπέρμα) from which all the rest was formed, composed of smooth triangles, fit to form the purest water, fire, and earth, and contains the three kinds of souls. It was divided into parts; the upper is the brain. Bone is formed from marrow mixed with sifted earth, repeatedly exposed to fire and earth, and for protection it was covered with flesh, composed of water, fire, and earth, soft flesh being made by adding an acid and salty ferment (ζύμωμα).

[1] Q, 77A–C.
[2] Hammond, (1), xxi, xxvi.
[3] Q, 69–70; Sprengel, (1), i, 347, compared the third with van Helmont's *Archeus*, see Vol. II, p. 234; Zeller, II, i, 845.
[4] Q, 77B. [5] G, 400c.
[6] Q, 90 f.; Cousin, xii, 239, 243; Zeller, II, i, 819, 841; this was developed by the Stoics.
[7] Zeller, (1), II, i, 805.
[8] E, 219*b*. [9] H, 186*b*. [10] E, 219*b*. [11] O, 242*a*; S, x, 4, 889*b*.
[12] H, 189*d*. [13] Cornford, (5), 224. [14] Q, 59D–E. [15] Q, 82–9.
[16] AH, 258; Cornford, CAH, vi, 330; Frank, 65, 129; M. Neuburger, (1), i, 164; Senn, *A. Med.*, 1930, xxii, 285, 291, 311; A. E. Taylor, (1), 448 f., 504 f., 608 f. (Pythagorean); id., (3), 315 (4 humours); Wellmann, *A. Med.*, 293, 302 f.

The brain is enclosed in the skull, and through an opening it continues as the marrow of the spinal column, protected by vertebrae.[1] Skin is a film formed by the drying of the surface of flesh; the skull is covered with skin only, cemented on by moisture from the sutures, and hair by moisture rising through punctures in the skin, formed by fire from the brain and partly evaporating.[2] Another account says that marrow, bone, flesh, and sinews (νεῦρα) are composed of the elements, and blood in a different way. In the course of nature sinew is formed from fibrin (ἐξ ἰνῶν) of the blood owing to affinity (ξυγγένεια), and flesh from the clots (παγέντος) produced when fibrin is separated. From sinews and flesh an oily glutinous fluid (synovial fluid) is formed, which cements flesh to bone and irrigates and nourishes marrow.[3] Otherwise flesh is formed by mixing due proportions of water, fire, and earth, and adding a ferment (ζύμη) composed of sour and salty parts (ἐξ ὀξέος καὶ ἁλμυροῦ ξυνθεὶς ζύμωμα).[4]

Disease arises when liquid decomposed flesh passes into the veins, mixes with various kinds of blood, air, colours, bitter, acid and saline properties, and all kinds of bile (χολή), serum (ἰχώρ) and phlegm (φλέγμα), which poison the blood and rush in all directions through the veins.[5] The origin of bile and phlegm (which are both acid) is given, and the way in which various diseases arise. 'Inflammations' are not due to phlegm but bile.[6] The temperature of the body is due to internal agencies.[7] Drugs should be avoided.[8]

The pathology in the *Timaios* is different from that in any known Greek work which might have been used by Plato, and is like that in old Indian medicine, of which he may have had some knowledge.[9]

The sperm contains in microscopic form the whole future man and consists of 'living things invisible for smallness'.[10] 'From the dead, living things and living men are produced,'[11] by spontaneous generation.

Air and drink both pass by the windpipe to the lungs, which are bloodless and act as a cushion and refrigerant of the heart.[12] The theory that part of a liquid drunk passes to the lungs is found in the Hippokratic work *On the Heart* (περὶ καρδίης).[13] Aristotle knew that no liquid passed to the lungs (p. 115). Fish breathe water (ὕδατος ἀνάπνευσιν):[14] Pliny[15] and Clement of Alexandria[16] knew that they breathe 'air mixed with water', and Galen[17] that water contains air and that the gills of fish replace lungs, but he thought pores in them admitted air but excluded water. Cardan[18] asserted that fish do not breathe air. Plato says of respiration (inspiration and expiration), 'it is by this function, active and passive, that the body, watered and cooled (?) (ἀρδομένῳ καὶ ἀναψυχομένῳ), is able to nourish itself and live'. This suggests that the air cools the body, but Aristotle[19] said Plato believed that respiration maintained

[1] Q, 73B–74D; A. E. Taylor, (1), 518, 527.
[2] Q, 76A–D.
[3] Q, 82C–E; AH, 310.
[4] Q, 74C.
[5] Q, 82E–83B.
[6] Q, 85B.
[7] Q, 88C.
[8] Q, 89B.
[9] Filliozat, (1), 193 f. (in detail).
[10] Q, 91; Cousin, xii, 242; Seneca, *Quaest. nat.*, iii, 29.3.
[11] J, 71*d*.
[12] Q, 70C; AH, 259.
[13] Wellmann, (1), 98–107.
[14] Q, 92B.
[15] ix, 6.
[16] *Strom.*, vii, 6; ANL, bk. xii, 430.
[17] *De usu part.*, vi, 9, Kühn, iii, 443 (q. Aristotle).
[18] *De Re Varietate*, vii, 37; 8°, Basel, 1557, 387.
[19] *De respirat.*, v, 472b.

the heat of the body, and Galen that Plato took his theory from Hippokrates who taught that respiration supplies the internal fire with fuel and at the same time prevents it by refrigeration from consuming its fuel too rapidly.[1] Plato[2] says the inspired air brings in fire, which maintains the vital heat. The mechanism of respiration depends on abhorrence of a vacuum. Air escaping from the lungs is replaced by air passing in through the pores of the skin, and air escaping from the skin is replaced by air passing in through the nose and mouth.

The theory that respiration occurs through the pores (πόροι, this could also mean φλέβες, or 'ways', *viae*, carrying πνεῦμα) of the skin, which is found also in Diokles of Karystos may even go back to Empedokles. Plato may have taken it from Diokles, or Philistion of Lokroi (399–37 B.C.), a member of Empedokles' school.[3]

A 'fount of fire (πηγὴ πυρός)' in the blood and veins heats the air falling into it, but that passing out is cooled. Thus the heat changes its position, and the backward and forward motion produces respiration. This depends on the same cause as storms, musical accord, the attraction of bodies to amber, and the hanging of iron rings one below the other from the Magnesian or Herakleian stone (the magnet), viz. some kind of motion going and returning in the plenum, a kind of circular impulsion (περίωσις, the περίστασις of the Stoics).[4]

Smell is due to effluvia from bodies carried by the air and passing through appropriate pores.[5] It is due to matter passing from one state to another, such as mist or smoke (air$\rightleftharpoons$water), since if we breathe through a cloth which filters off the smoke (καπνός) but lets the air through, the latter has no smell.[6] Sweet smells nourish the nostrils, which waste in their absence. Aristotle said some Pythagoreans believed that certain animals were nourished by smell.[7] Respiration is accessory to digestion. Fire divides the food, air as it sways up and down in the body pumps the comminuted food from the stomach into the veins, from which nourishment passes to the whole body.[8]

Plato had no knowledge of nerves, of which (πόροι) Aristotle had at least a rudimentary idea, although he did not trace them to the brain.[9] Plato's theory of vision, which may be due to Empedokles,[10] is that a visual ray (ὄψις) issues from the eye and meets a flame (φλόξ) streaming off every object and having its particles so adjusted to those of the visual current as to excite sensation (φλόγα τῶν σωμάτων ἑκάστων ἀπορρέουσαν, ὄψει ξύμμετρα μόρια).[11] The pupil of the eye acts as a mirror.[12] The various colours are explained in detail in

1 Ross, (3), 312.
2 Q, 78–9; AH, 294 f.; A. E. Taylor, (1), 556, 956.
3 Wellmann, (1), 1901, 45, 67, 72, 83, 89, 98, 101; Jaeger, (1), 212, 216, thinks from Diogenes of Apollonia, not Empedokles.
4 Q, 80; B, 533*i*; J, 112*b*; *Works*, iv, 294, 299; AH, 298; A. E. Taylor, (1), 579; TM, ii, 254, 271, 340.
5 D, 76*d*; *Works*, iii, 11–12; from Demokritos ?
6 Q, 66–7; AH, 244; A. E. Taylor, (1), 471–2 (from Anaxilaos).
7 *De sensu*, v, 445*a*.
8 Q, 80D–E.
9 AH, 240, 275, 311.
10 Freeman, (1), 1949, 238; Archytas thought the visual ray was sufficient; AH, 248 (not Empedokles' theory); Theophrastos, *De sensu*, 5; *Opera*, Paris, 1866, 321, attributes it to Plato; Demokritos thought an actual image of the object was thrown off Plato that the object emitted particles of fire.
11 Q, 67C; D, 76*c*–*d*.
12 W, 133*c*.

terms of the different sizes of the fire particles in the two streams; there are three primary colours, black, white, and red, the others being formed from these by mixing.[1]

Taste is caused by soluble things.[2] Rough, earthy, particles produce astringent or harsh tastes, alkaline particles bitter or saline, those sharing the warmth of the mouth and mounting to the brain pungent, those in liquids containing earth and bubbling and fermenting (ζύμωσιν) acid, those having an affinity to the tongue in its normal condition sweet (only this kind do not disturb the natural particles of the tongue).

Hearing is due to a stroke (θῶμεν) transmitted through the air to the ear, and passed through the brain and blood to the soul, producing a motion ending in the liver.[3]

General

Statics (ἡ στατική) is the science of weighing the heavy and light;[4] a body is in equilibrium (ἰσοπαλές) when equal and opposite forces act on it, as in an equally loaded balance (πλάστιγγος).[5]

The world is a sphere freely suspended in space with a layer of air around it, and above this ether (pure air). It was made to move uniformly, circularly, without changing its place, by turning on itself (ἐν ἑαυτῷ περιαγαγών).[6] If viewed from outside, it would resemble a ball painted in various colours. If a passage were bored through the earth and water poured down, it would fall to the further side, then rise again, and continue to oscillate.[7]

Amber (ἤλεκτρον) and the Herakleian stone (λίθος Ἡρακλεία, the magnet) show a wonderful power of attraction (ἕλξις).[8] The torpedo fish (ναρκη), which causes numbness by its shock,[9] and the Northern lights,[10] are mentioned but not related to electricity. Geological strata, waters in the earth, denudation,[11] and a rudimentary theory of evolution,[12] are mentioned. The mythical island Atlantis, which disappeared, has been located 'from China to Peru'.[13]

Gold, 12 times the value of silver,[14] is soft compared with hard iron,[15] and is tried in the fire[16] and on the touchstone (ἡ βασανος λίθος).[17] The touchstone (βασανος) is mentioned by Theognis (509 B.C.)[18] and its use by Herodotos.[19] It is named by ψ-Aristotle[20] and Theophrastos.[21] It was also called the Lydian stone (λίθος Λυδία).[22]

[1] Q, 67E–68E; AH, 250–2; Hopkins, *Isis*, 1925, vii, 61; A. E. Taylor, (1), 480; *id.*, (3), 134, 327.
[2] Q, 65–6; AH, 238; A. E. Taylor, (1), 467–70; TM, i, 179; ii, 286.
[3] Q, 67B. [4] A, 160*c*. [5] Q, 63A–C.
[6] Q, 34A; Zeller, (1), II, i, 808, and Archer-Hind, 132 (from Böckh), thought that Plato assumed that the sphere was at rest.
[7] J, 108*c*; Q, 40B; *Works*, i, 117–18, 121; ii, 344.
[8] Q, 80C. [9] D, 80*a*. [10] K, x, 14, 616*b*.
[11] J, 107*e* f.; R, 111*a–d*; *Works*, i, 118; ii, 418.
[12] P, 270*e* f., 273*e*; *Works*, iii, 187.
[13] Q, 24–5; AH, 77; Borchardt, *Isis*, 1928, x, 106; Friedländer, i, 242–75; TM, i, 257–333.
[14] V, 231*d*. [15] S, i, 13, 503*a*. [16] K, ii, 20, 413*d*; vi, 15, 503*a*.
[17] C, 486*d*; S, i, 15, 654*a*. [18] LSJ, 309; Schrader, (1), 153.
[19] vii, 10; 'pure gold is not used by itself, but when we rub it along with other gold (παρατρίψωμεν χρυσὸν ἀκήρατον ἄλλῳ χρυσῷ), we perceive which is better.'
[20] *De color.*, iii, 16.
[21] *On Stones*, 4, 45.
[22] Theophrastos, *On Stones*, 4; Clement of Alexandria, *Strom.*, i, 9; ANL, iv, 379.

Hesiod's theory of the 'ages of metal' and the 'races of men', gold, silver, bronze, and iron,[1] which have little relation to real users of the metals, was worked up by Plato[2] into what he calls a 'Phoenician lie': gold is mixed with the souls of rulers, silver with those of soldiers, and copper with those of peasants and artisans, yet any one may have offspring of the other. Eisler[3] thinks it may have a Mithraic origin, related to the myth of Kadmos (a Phoenician) of armed men growing from dragon's teeth sown in the ground, and may have come from Babylonian alchemical ideas.

The walls of the mythical city Atlantis, beginning with outside, were of bronze (or copper), tin, and ὀρείχαλκος (*oreichalkos*), the last of a fiery resplendance; it was dug as such from mines and was next in value to gold, but was only a name in Plato's time.[4] The literal meaning of ὀρείχαλκος is 'mountain copper' but the metal is usually supposed to be brass.[5]

Iron is softened by heating (καθάπερ εἰς πῦρ σίδηρον ἐντεθέντα).[6] The 'piece of iron' containing a flaw[7] is of doubtful meaning. The spindle of ἀδάμας, around which the sirens turned the cosmos of eight spheres (7 planets and the sphere of the fixed stars) of different colours, was probably steel.[8] The blue κύανος[9] is probably lapis lazuli rather than steel.

White lead (ψιμυθίον, *psimuthion*) was used to whiten yellow hair — 'platinum blondes'.[10] A 'small book on salt by a wise man'[11] was perhaps religious. Water is easily contaminated and laws are made to preserve it.[12] Human dispositions are due to heat, wind, water, and food from different kinds of earth in various places.[13] Workers should be restricted to one trade.[14] The 'torch steeped in drugs' used by physicians and prophets was perhaps sulphured.[15] Encaustic painting in wax and on ivory,[16] and corks (φελλῶν),[17] are mentioned.

Plato uses the first Greek name for the planets (πλανητά) (of which there are five, with the Sun and Moon making seven).[18] He knew of the zodiac.[19] The planets move in circles, the most perfect kind of motion. Knowledge of them came from Syria and Egypt, free from rain and with clear skies.[20] The movements and positions of the planets at the time of birth have an influence.[21]

The influence of Oriental astrology on Plato, formerly denied,[22] is now thought probable.[23] There are traces in the last book of the *Laws*[24] and it appears, with Persian

[1] Bury, CAH, iv, 476.
[2] K, iii, 21, 414*c*; Jowett, 1871, ii, 36, 242; Plato, *Works*, ii, 98; J. A. Stewart, (1), 473; cf. Aristotle, *Politica*, ii, 2; *Opera*, Paris, 1848, i, 502.
[3] (1), 1910, 295, 299; (3), 1925, 84; *Isis*, 1949, xl, 108.
[4] R, 114*e*.
[5] Cousin, xii, 262; J. A. Stewart, (1), 1905, 460; R. Watson, *Chemical Essays*, 1796, iv, 85; Schrader, (2), 1890, 197, suggested electrum; Rossignol, 1863, 211–331 (220 f.) thought it was mythical.
[6] S, ii, 9, 666*b*.
[7] O, 267*e*; not 'cast iron' as Lippmann, (1), ii, 39, thought.
[8] K, x, 13, 614*a*; Kerényi, *A. Rel.*, 1928, xxvi, 328; on Er, son of Armenios, see Gruppe and Pfister, Ro., vi, 37; Leonhard, *A. Rel.*, 1922, xx, 197; the colours of planets is an old Babylonian idea.
[9] J, 113*c*.
[10] E, 217*d*.
[11] H, 177*b*.
[12] S, viii, 11, 844*a–d*.
[13] S, v, 14, 747*d*.
[14] K, iv, 1, 421*a*; S, viii, 11, 846*d*.
[15] G, 405*a*; *Works*, ii, 323.
[16] Q, 26C; Pliny, xxxv, 41.
[17] P, 288*d*.
[18] Q, 38D.
[19] N, 247*a*; through Eudoxos: Kerényi, *A. Rel.*, 1923, xxii, 245.
[20] S, vii, 22, 822*a*; x, 8, 897, 899*b–e*.
[21] H, 188*a*; K, viii, 3, 546*a*.
[22] Bouché-Leclercq, 1899, 63, 601.
[23] Boll, (3), 92 f.
[24] S, 966*d*–967*a*.

dualism, in the *Epinomis*. Plato believed in incantations, sorcery, 'bindings', and the use of wax images and poisons in magic,[1] all commonplaces among educated Greeks.

The Epinomis

Opinions are still divided as to whether the *Epinomis* ('supplement to the *Laws*') is the last work of Plato, or by a younger member of his school such as Philip of Opos (*c.* 350 B.C.), or by a Pythagorean. Leisegang says the author is unknown, des Places that it is Plato.[2] Two main teachings in it new to Plato are: (1) the recognition of ether (αἰθήρ) as a fifth element, (2) the assumption of an evil 'world-soul' in the universe.

The names ἀήρ and αἰθήρ occur in Homer for the lower and upper (heaven or sky) parts of the atmosphere, Empedokles used it for air (see p. 17).[3] Plato[4] recognised a purer part or ether and a thick part, cloud or mist, as well as 'other nameless parts formed by the inequalities of the triangles'. The 'five bodies' (not 'elements') appear in the *Epinomis* in the order: fire, water, air, earth, and ether.[5] Simplikios (6 cent. A.D.) says Plato assumed five 'bodies' (πέντε σχήματα καὶ σώματα); this was certainly true for Speusippos, head of the Academy in 347–39 B.C., and Xenokrates, who followed him (339–14 B.C.).[6] Plato's original derivation of αἰθήρ was from ἀεὶ θέω, 'I run', something always moving: 'it always runs and flows about the air.'[7]

The name has also been connected with the Persian *atar*, fire, or Atar son of Ahura-Mazda and 'wise master of the kingdom of light',[8] or Aitherie the daughter of Helios, whose tears when she was turned into a tree solidified into flame-coloured amber.[9]

In the *Epinomis* fire is associated with gods; ether, air, and water with demons; earth, metals, plants and animals with mortals.[10] There is a good soul in the universe, and another soul which is the cause of evil.[11] There are planetary gods and demons of the air and ether as well as the Olympian gods.[12] These views are said to show Orphic, Babylonian, and especially Iranian influences,[13] perhaps also Indian through Persia.[14]

The small work on *The Soul of the World and Nature* (περὶ ψυχᾶς κόσμου καὶ φύσιος) attributed to Timaios of Lokroi, written in conventional Doric, was probably compiled about 20 B.C.–A.D. 120 as a fairly correct summary of Plato's *Timaios*, slightly tinged with Aristotelian and Stoic ideas.[15] It mentions gold, silver, copper, tin, lead, and σταγών (perhaps steel, or brass),[16] which are 'fusible' forms of water, with sulphur, pitch, soda, salt, alum, and 'similar stones (λίθοι τε)', as 'friable' forms. The four colours are white, black, brilliant (λαμπρόν) and red. The abhorrence of a vacuum

[1] S, xi, 12, 932*e*–933*e*; Thorndike, (1), i, 22 f., etc.
[2] Des Places, ed. of *Epinomis*, Paris (Coll. Budé), *Oeuvres*, 1956, XII, ii, 93, 109, 112; Festugière, (1), ii, 127, 157, 196–218; J. Harward, *The Epinomis of Plato*, Oxford, 1928, 26, 33, 37; Leisegang, PW, 1950, xl, 2342; A. E. Taylor, (3), 500 ('playful irony', mathematics hopeless); Ueberweg, (1), i, 324; Zeller, II, i, 801, 1008, 1040, 1044.
[3] Gilbert, 17. [4] Q, 58*d*. [5] Harward, 13, 41, 91, 123.
[6] Zeller, (1), II, i, 951, 1008, 1024.
[7] G, 410B; Aristotle, *De cœlo*, i, 3, 271*a*; Gilbert, 19; Zeller, II, ii, 437.
[8] Clemen, *A. Rel.*, 1913, xvi, 101 (118); Ehrenfeld, in Diergart, (1), 65; Eisler, (1), 1910, i, 91, 360.
[9] Knaack, PW, i, 1094. [10] Hopfner, PW, XIV, i, 308–9. [11] T, 9, 10. [12] T, 5, 8.
[13] Bousset, *A. Rel.*, 1901, iv, 256; Festugière, (1), ii, 127; *id.*, *Rev. Philol.*, 1947, xxi, 5–45; Gressmann, (2), 8; Gruppe, Ro., iii, 2268; Harward, 68; Mead, (1), i, 437, 441; G. Murray, (1), 55, 169 f., 173; Reitzenstein, (7), 6, 34, 67, 70, 147, 167; *id*; (8), 129 (*Timaios*); Ross, (5), 139, 239; J. A. Stewart, (1), 152; A. E. Taylor, (1), 194, 488; T. Whittaker, (1), 242; Zeller, (1), II, i, 474.
[14] Filliozat, (1), 209 f.
[15] Hermann, ed. of Plato's *Timaios*, Leipzig, 1852; *Works*, vi, 145; Frank, 142; TM, ii, 390; Susemihl, ii, 336; A. E. Taylor, (1), 663.
[16] LSJ, 1631; Burges, *Works of Plato*, vi, 159, thought it was mercury (known to Aristotle).

is taught. The word ὕλη is used in the Aristotelian sense of primary matter; it has not this meaning in Plato.

Plato's school was continued in the Middle Academy, which opposed Stoicism and was founded by Arkesilaos of Pitane (Aeolia), *c.* 315–241 B.C. and ended with Karneades (214/13–129/8 B.C.), who lectured in Rome from 156/5 B.C., and Kleitomachos of Carthage (d. *c.* 110 B.C.). The New Academy, which opposed Scepticism and tried to combine the doctrines of Plato and Aristotle, included Philo of Larissa (160/59–80 B.C.), Antiochos of Askalon (*c.* 130/20–68 B.C.), Areios Didymos of Alexandria (I cent. B.C. and counted as a Stoic), and Thrasyllos of Alexandria (d. A.D. 36), an astrologer.[1] The Neoplatonic school will be dealt with separately (see p. 225). The school of Athens was finally closed by the Emperor Justinian in A.D. 529.

[1] Mahaffy, (1), 374 f.; Susemihl, i, 116 f.

CHAPTER IV

ARISTOTLE

Aristotle (Ἀριστοτέλης) was born in 384 B.C. at Stageiros in Chalkidike, an old Ionian settlement in Macedonia, then ruled by king Amyntas II, to whom his father was physician. The Macedonians belonged to the same race as the Greeks and Aristotle was always regarded as a Hellene. He was said to have been taught medicine by his father, but both his parents died when he was young and Aristotle suggests[1] that in medicine he was a layman. In 368/7 B.C. he went to Athens to study with Plato, who was away, and he spent three years in intensive private study. He was rich and spent large sums on books. When Plato returned, Aristotle spent twenty years in his school, first as a pupil and then as a friend. Stories of quarrels are probably baseless. In 343/2 B.C. Aristotle was called by Philip, king of Macedon, as tutor to Alexander the Great, then aged 13, and he occupied this post, which brought him in contact with court life and confirmed his rather worldly disposition, for three years until Alexander became regent. Master and pupil always respected one another, although Aristotle disapproved of Alexander's plan for the fusion of the Greeks and Persians.

Aristotle returned to Athens in 335/4 B.C. and received permission to teach in the Lykeion, a gymnasium attached to the temple of Apollo Lykeios, the lecture-place being called ὁ περίπατος, 'the covered walk'; hence his school was called later 'the Lyceum' and his followers 'the Peripatetics'. He collected a great library and a museum. On the death of Alexander in 323 B.C. there was an outbreak of anti-Macedonian feeling in Athens, and Aristotle, no doubt remembering the fate of Sokrates, left his school in charge of Theophrastos and retired to Chalkis in Euboia where he died in 322 B.C. of an old gastric complaint. Aristotle was described as thin-legged, bald in later life, speaking with a lisp, noticeably well-dressed, and with a mordant wit.[2]

[1] *De divinatione*, i, 463.

[2] H. G. Apostle, *Aristotle's Philosophy of Mathematics*, Chicago, 1952; C. Baeumker, 210–300; Benn, i, 314, 361; F. Biese, *Die Philosophie des Aristoteles in ihrem inneren Zusammenhange*, 2 vols., Berlin, 1835–42; J. W. Blakesley, *A Life of Aristotle*, Cambridge, 1839; Brandis, (1), 1853, II, ii; 1860, III, i; F. Brentano, *Aristoteles und seine Weltanschauung*, Leipzig, 1911; *id.*, *Aristoteles Lehre vom Ursprung des menschlichen Geistes*, Leipzig, 1911; Brunet and Mieli, 223, 332; J. T. Buhle, *Aristotelis Opera Omnia*, Bipont, 1791, i, 1 f. (life, MSS., eds.); H. Carteron, *La notion de force dans le système d'Aristote*, 1923; H. Cherniss, *Aristotle's Criticism of Plato and the Academy*, i, Baltimore, 1944; L. Cooper, *Aristotelian Papers*, Ithaca, N.Y., 1939; Cornford, CAH, vi, 333; Deussen, (1), II, i, 315; Farrington, 1944 (1949), i, 102; Gerke, PW, ii, 1012–55; Gilbert, 175–205; P. Gohlke, *Hermes*, 1924, lix, 274–306 (Die Entstehungsgeschichte der naturwissenschaftlichen Schriften des Aristoteles); G. Grote, *Aristotle*, ed. Bain and Robertson, 2 vols., 1872, 2 ed. 1880; O. Hamelin, *Le Système d'Aristote*, 1920; W. A. Hammond, (1), *Aristotle's Psychology. A Treatise on the Principle of Life* (*De*

Plato's teaching seems to have been rather informal, but Aristotle gave carefully prepared lectures and set problems and investigations to his pupils, using the results in his own writings. Strabo and Plutarch say that his library

FIG. 2. ARISTOTLE (384–322 B.C.).

and works were hidden in a pit or cellar (διῶρυξ) from fear that they might be appropriated for the royal library at Pergamos. They were found in very poor

Anima and Parva Naturalia), 1902; T. Heath, *Mathematics in Aristotle*, Oxford, 1949; A. Heller, *Geschichte der Physik*, Stuttgart, 1882, i, 39 f., 62 f.; W. Hertz, (1), 1 f., 24 f.; Hoefer, NBU, 1852, iii, 199; *id.*, (1), 1866, i, 97; W. Jaeger, (3), (4); H. H. Joachim, (1), Aristotle's conception of chemical combination, in *J. of Philology*, 1904, xxix, 71–86; A. Jourdain, (1); N. Kaufmann, *Die teleologische Naturphilosophie des Aristoteles*, Paderborn, 1893; H. M. Leicester, *Chymia*, 1961, vii, 9 (21); G. H. Lewes, *Aristotle. A Chapter from the History of Science, including Analyses of Aristotle's Scientific Writings*, 1864; Lippmann, *A. Nat.*, 1910, ii, 233–300; *id.*, (1), ii, 64–156; T. E. Lones, *Aristotle's Researches in Natural Science*, 1912 (biology); Lorscheid, *Aristoteles' Einfluss auf die Entwickelung der Chemie*, Münster, 1872; A. Mansion, *Introduction à la physique aristotélicienne*, 2 ed., Louvain and Paris, 1946 (bibliography, x–xvi); S. Mansion, *Le Jugement d'Existence dans Aristote*, Louvain and Paris, 1946; A. Nyman, *Lunds Univ. Årsskrift*, 1921, xvii, no. 3 (A.'s Physics); T. W. Organ, *An Index to Aristotle*, Princeton, 1949; C. Piat, *Aristote*, Paris, 1903; C. Prantl, (1) Keime der Alchemie bei den Alten, in *Deutsches Vierteljahrs Schrift*, Stuttgart, 1856, no. 73, p. 135 (anonymous); (2) *Aristoteles' Werke. Griechisch und Deutsch und mit sacherklärende Anmerkungen*, Leipzig, 2 pts., (*a*) *Acht Bücher Physik*, 1854; (*b*) *Vier Bücher über das Himmelsgebäude und Zwei Bücher über Entstehen und Vergehen*, 1857; Robin, 240; E. Rolfes, (1) *Die substantielle Form und der Begriff der Seele bei Aristoteles*, Paderborn, 1896; *id.*, (2) *Die Philosophie des Aristoteles*, Leipzig, 1923; V. Rose, (1); F. Rosenberger, i, 16; W. D. Ross, (1)–(4); H. Seidel, Die Lehre des Aristoteles vom νοῦς, in *Jahresbericht Königlicher Gymnasium zu Gross-Strehlitz*, Gross-Strehlitz, 1906; R. Shute, *On the History of the Process by which the Aristotelian Writings arrived at their Present Form*, Oxford, 1888; E. E. Spicer, *Aristotle's Conception of the Soul*, 1934; A. Stahr, (1) DBM, i, 317; *id.*, (2) *Aristotelia*, 2 vols., Halle, 1830–2; J. Stenzel, *Zahl und Gestalt bei Platon und Aristoteles*, 2 ed., Leipzig and Berlin, 1933; Strunz, (1), 66; A. E. Taylor, (1) *Aristotle and his Predecessors*, Chicago, 1907; *id.*, (2) *Aristotle*, 1943; T. Taylor, *A Dissertation on the Philosophy of Aristotle*, 1812; Ueberweg, (1), i, 347–401; E. Wallace, *Outlines of the Philosophy of Aristotle*, Oxford, 1875; Wenrich, 126; Whewell, (1), i, 29 f., 77, 341; P. Wilpert, *Zwei Aristotelische Frühschriften über die Ideenlehre*, Regensburg, 1949; Zeller, (1), 1879, II, ii[3], 1–806.

condition by Apellikon of Teos, who edited them badly, about 100–90 B.C. and brought them to Athens. In 86 B.C. they were sent to Rome and edited by Tyrannion and Andronikos of Rhodes.[1] The Alexandrian Library had copies of the more important works, and the present text is based on the work of scholars there.

Works

Apart from some of his much earlier works, all Aristotle's writings are complete. They were perhaps written soon after 335 B.C., and by Aristotle himself and not from notes taken in his lectures,[2] although many of them show a lack of order and finish. They are very voluminous;[3] in the Berlin edition the text fills about 130,000 lines. The modern editions comprise about forty works, but a few are spurious. They have been classified as: (1) Logical treatises, later called the *Organon*, including Aristotle's method of the syllogism; (2) Metaphysics; (3) Science (including Physics, Biology, and Psychology); (4) Ethics, Rhetoric, Economics, and Politics; (5) the history and theory of Art, Poetry. The logical works were the first known in later Europe, through Latin translations by Boethius (*c.* A.D. 480–524); the others were first known in Latin versions from Arabic, the Greek texts being available only after about 1225–50.[4] Aristotle replaced Plato, and his teachings became authoritative in the Roman Catholic Church after their accommodation by St. Thomas Aquinas. Aristotle's works were first printed in the 15 cent. in Latin translations from Arabic with paraphrases and commentaries by Averroës.[5] The basic text is that edited for the Berlin Academy by Immanuel Bekker:

A. *Opera*, 4°, Berlin; 2 vols. text, 1831; 1 vol. Latin tr., 1831 (the old Latin tr. often does not correspond with the Greek); 1 vol. Fragments and Scholia, 1836; 1 vol. Scholia and Index (by Bonitz), 1870. The works are quoted by page and column (*a*, *b*) of this ed. (Another ed., 11 vols. 8°, Oxford, 1837.)
B. *Opera omnia*, ed. Dübner, Bussemaker, and Heitz, with new Latin tr., 5 vols., Paris (Didot), 1848–50–54–57–74.
C. *The Works of Aristotle translated into English*, 12 vols., Oxford; var. trs. and dates, see sep. treatises below. For texts and trs. in Loeb eds. see below.
D. *Oeuvres*, tr. E. G. Saint-Hilaire, Paris, ref. under sep. treatises.
E. *Werke. Griechisch und Deutsch*, 9 vols., Stuttgart, 1850 f.
F. *Commentaria in Aristotelicum Graeca*, 23 vols. in 29 parts, Berlin, 1882–1909 (Ueberweg, (1), i, 354).
G. *Supplementum Aristotelicum*, 3 vols., Berlin, 1885–6–93. This contains the commentaries of Alexander Aphrodisias *de Mixtione*, etc., of interest to us.

There is a good deal of repetition. The style is very terse; some sentences have no subject, others no verb and the meaning is often lost in a maze of parentheses.[6] He often corrects or modifies his views. In discussing any matter he usually first gives a summary of earlier investigations, sometimes naming the authors and sometimes only remarking 'some say (ὥς ἔνιοί φασι)', and then proceeds to refute them and give his own views. This became the classical style for scientific treatises. Notable are his liking for order, his common-

[1] Susemihl, ii, 297 f.; Ueberweg, (1), i, 364.
[2] Ross, (1), 16.
[3] List in Fabricius, (1) (*b*), iii, 207–84, 388–407; Deussen, (1), II, i, 326, 334 f.
[4] A. E. Taylor, (3), 14, 21. [5] Klebs, 44 f.
[6] Hicks, (X (*b*) (see p. 74), 213, 293, 453, 469.

sense, and his desire to give as complete and coherent an account as possible. He usually finishes by saying 'we have given account of', 'we have given the reason why', or 'so much for the cause'. His criticisms of earlier philosophers, including Plato, are usually severe, although he always treated Demokritos with respect. He paid much attention to exact terminology and invented some new names (e.g. *entelechy*), but did this sparingly.[1]

Aristotle divided philosophy (φιλοσοφία, scientific knowledge in general) into (i) theoretical (θεωρητική), (ii) practical (πρακτική), and (iii) creative (ποιητική). He subdivided (i) into (*a*) physics (φυσική), (*b*) mathematics (μαθηματική), and (*c*) theology (θεολογική), the highest in rank. He subdivided (ii) into (α) ethics (ἠθική), (β) economics (οἰκονομική), and (γ) politics (πολιτική). He followed Plato in supposing that real knowledge is only of the general, and was the founder of the inductive method, reasoning from the particulars to the general.[2] A summary of the titles of works referred to is given below. Some are not by Aristotle but by members of his school, or others.[3] The order of composition is doubtful, but I, II, IV, V (early parts), X (3), XII (older parts) were probably earlier than III, VI–IX. The physical works may have been revised by Aristotle, and the original order in each work may also have been disturbed.[4] Although in his biological works Aristotle is said to show that he was a good *observer*, his physical works give no indication that he was an *experimenter*.[5]

I. Physics.
II. On the Heavens.
III. Meteorology.
IV. On Coming to Be and Passing Away.
V. History of Animals.
VI. Parts of Animals.
VII. Motion of Animals.
VIII. Walking of Animals.
IX. Generation of Animals.
X. On the Soul.
XI. Parva Naturalia:
- (i) On Sense and Sensibility.
- (ii) On Memory and Recollection.
- (iii) On Sleeping and Waking.
- (iv) On Sleeplessness.
- (v) On Divination by Dreams.
- (vi) On Length and Shortness of Life.
- (vii) On Youth and Old Age, on Life and Death.
- (viii) On Respiration.

XII. Metaphysics.
XIII. Fragments.
- α′ Mechanics.
- β′ On Colours.
- γ′ On Marvellous Things Heard.
- δ′ Problems.
- ϵ′ On the Universe.
- ζ′ On Plants.
- η′ Minor works:
  - (i) On Things Heard.
  - (ii) Physiognomics.
  - (iii) On Indivisible Lines.
  - (iv) On Winds.
- θ′ On Spirit.
- κ′ Lost works.

I. *Physics* or *Lectures on Physics* (φυσικὴ ἀκρόασις, *Physica Auscultatis*), 8 books,[6] deals mainly with motion (in which Aristotle included growth or change in general).

[1] Stephanides, *Isis*, 1925, vii, 468.
[2] Stahr, (1), 335; Zeller, (1), II, ii, 240, 306 f., 312, 343 f.
[3] Susemihl, i, 155 f. [4] Gohlke; A. Mansion, 1–37. [5] Lee, III (*e*), xxvi–xxviii.
[6] Text: ed. (*a*) Prantl (Teubner), 1879, (*b*) W. D. Ross, Oxford, 1936 (with commentary); (*c*) W. Ross, Oxford, 1950; (*d*) H. Carteron (with French tr.), 2 vols., Paris (Budé), 1926–31, (*e*) P. Wicksteed and F. M. Cornford, 2 vols., 1929–35 (Loeb, with English tr.), (*f*) Prantl, (2) *a*, 1854; (*g*) English tr., R. P. Hardie and R. K. Gaye, C, 1930; (*h*) French tr., D, 2 vols.,

II. *On the Heavens* (περὶ οὐρανου, *De Coelo* or *Caelo*), 4 books,[1] is mainly on astronomy[2] but has sections on the four elements.

III. *Meteorology* (μετεωρολογικά, μετεωρολογικων, *Meteorologica*), 4 books,[3] written in a clear easy style.[4] The end of bk. iii, ch. 6, has no relation with the earlier part and is sometimes called ch. 7; it seems to belong to bk. iv and in Arabic translations it begins bk. iv.[5] Book iv, which forms a separate treatise, was perhaps added by Aristotle himself.[6] The suggestion that it is by Straton (286–68 B.C.)[7] is not generally accepted.[8] Parts of it are mentioned in genuine works.[9] It contains material of chemical interest.[10] A work *On Metals* (or *Mines*) (περὶ μετάλλων) mentioned in old lists is not extant, since it was probably not the *Lapidary* of ψ-Aristotle known in Arabic.[11]

IV. *On Coming to Be and Passing Away* (περὶ γενέσεως καὶ φθορᾶς; *de generatione et corruptione*, or *de ortu et interitu*), 2 books,[12] is most important from the chemical standpoint.

V. *History of Animals* (περὶ τὰ ζῷα ἱστορίαι, *Historia animalium*, *de animalibus historia*), 9 books.[13]

1862. Bk. vii is said to be spurious and the text is uncertain: Diels, *Abhl. Akad. Berlin, phil.; hist. Kl.*, 1882, no. 1; R. Shute, *Anecdota Oxoniensia, Classical Series*, Oxford, 1882, I, iii L. Spengel, *Abhl. Akad. Munich, Philos. philol. Cl.*, 1841, III, ii, 305–50; Ueberweg, (1), i, 368.

[1] Text: ed. (*a*) Prantl (Teubner), 1881, (*b*) D. G. Allan, Oxford, 1936, (*c*) W. K. C. Guthrie, 1939 (Loeb, with English tr.), (*d*) Prantl, (2), *a*, 1854; (*e*) English tr., J. L. Stocks, C, 1922, ii.

[2] M. A. Orr, 94, 103.

[3] Text: ed. (*a*) Bekker, Berlin, 1829 (with index), (*b*) J. L. Ideler, *Meteorologia veterum Graecorum et Romanorum*, Berlin, 1832, prolegomena to (*c*) J. L. Ideler, *Aristotelis Meteorologicorum*, 2 vols., Leipzig, 1834–6 (text, Latin tr., introd. and commentary, with extracts from commentaries), (*d*) F. H. Fobes, Cambridge, Mass. (Harvard Univ. Press,) 1918 (with index); (*e*) H. D. P. Lee, text (*d*) and English tr., 1952 (Loeb); (*f*) English tr., E. W. Webster, C, 1931, iii; (*g*) French tr., D, 1863, (*h*) do., J. Tricot, 1955. Commentaries in F, 1899, iii: (*j*) by Alexander of Aphrodisias, ed. Hayduck, (*k*) by Olympiodoros, ed. Stüve, (*l*) by John Philoponos, ed. Hayduck.

[4] H. Strohm, *Philologus Suppl.*, 1935, xxviii, 1–84 (Untersuchungen zur Entwicklungsgeschichte der Aristotelischen Meteorologie; does not consider bk. iv); C. Thurot, *Rev. Archéol.*, 1869, xx, 415; 1870, xxi, 87, 249, 339, 396 (end) (Observations critiques sur les Meteorologica d'Aristote); Zeller, (1), II, ii, 471–4 (summary).

[5] Jourdain, (1), 168.

[6] Capelle, PW, II Reihe, 1931, vii, 278; Diels, (2), 28; Gerke, PW, ii, 1046; Ueberweg, (2), i, 175; Zeller, (1), II, ii, 87.

[7] Gilbert, 14; Hammer Jensen, *Hermes*, 1915, l, 113; Lippmann, (1), i, 139; *Isis*, 1928, xi, 155; A. Mansion, 16.

[8] Ingemar Düring, *Göteborgs Högskolas Årsskrift*, Göteborg, 1944, l, no. 2 (Aristotle's Chemical Treatise); Gohlke, 275 (genuine); Lee, III (*e*), xiii f.; Regenbogen, PW, 1950, Suppl. vii, 1418 (perhaps by Theophrastos); W. D. Ross, (1), 11 (possibly by Aristotle, but out of place); Thorndike, (1), ii, 249.

[9] IV, i, 2, 317*a* (Prantl, (2) *a*, 365); V, ii, 9, 655*b*; IX, ii, 6, 743*a*; iii, 11, 762*a*; Brandis, (1), II, ii, 1076; Ideler, III, (*c*), I, x, 33; Zeller, (1), II, ii, 87.

[10] Hoefer, (1), i, 97.

[11] V. Rose, (1), 255.

[12] *Text:* ed. (*a*) Prantl, 1881 (Teubner); (*b*) *id.*, E, ii (with tr.), 339–487; (*c*) H. H. Joachim, *Aristotle on Coming-to-Be and Passing Away: a Revised Text with Introduction and Commentary*, Oxford, 1922 (criticises texts of Bekker and Prantl; some mistakes in chemistry in commentary, e.g. p. 188), (*d*) W. S. Hett, in *Minor Works* of A., 1936 (Loeb), 459–507 (with tr.), (*e*) English tr. T. Loveday and E. S. Forster, C, 1913, vii; French tr. D, 1866 (with Appendix, *De Xenophane, Zenone, et Gorgia* — see Gomperz, (1), i, 550), German tr. in (*b*); W. J. Verdenius and J. H. Waszink, *Aristotle on Coming-to-be and Passing-away. Some Comments*, Leiden, 1946.

[13] *Text:* (*a*) *De Animalibus Historia*, ed. J. G. Schneider, 4 vols., Leipzig, 1811, (*b*) *Historia Animalium*, ed. Bekker, Berlin, 1829, (*c*) *Aristoteles' Thierkunde. Kritisch-berichtigter Text, mit deutscher Übersetzung*, ed. H. Aubert and F. Wimmer, 2 vols., Leipzig, 1868 (7 plates), (*d*) *De Animalibus*, ed. R. Dittmeyer, Leipzig, 1907 (Teubner), (*e*) English tr., Cresswell,

VI. *Parts of Animals* (περὶ ζῴων μορίων, *de partibus animalium*) 4 books.[1]

VII. *Motion of Animals* (περὶ ζῴων κινήσεως, *de animalium motione*).[2]

VIII. *Walking of Animals* (περὶ ζῴων πορείας, *de animalium incessu*).[3]

IX. *Generation of Animals* (περὶ ζῴων γενέσεως, *de animalium generatione*), 5 books.[4] The stories in late authors[5] that Alexander the Great sent Aristotle specimens of all kinds of animals (including elephants) on his campaigns[6] are fictitious, although new sources of information became available, perhaps also to Aristotle, in Alexander's expeditions to the East.[7] Kallisthenes, a pupil and relative of Aristotle, accompanied Alexander to the East.[8] In Arabic stories Aristotle himself accompanied Alexander and gave him advice.[9] Aristotle[10] refers to a now lost work on anatomy (ἀνατομή) illustrated with diagrams, and he seems to have vivisected a chameleon.[11]

X. *On the Soul* (περὶ ψυχῆς, *de anima*), 3 books.[12]

XI. *Parva Naturalia*, the general title of a collection of small tracts.[13]

(i) *On Sense and Sensibility* (περὶ αἰσθήσεως καὶ αἰσθητῶν, *de sensu et sensibilibus*).

1862, (*f*) D'Arcy Thompson, C, 1910, iv, (*g*) J. B. Meyer, *Aristoteles Thierkunde. Ein Beitrag zur Geschichte der Zoologie, Physiologie und Philosophie der Alten*, 1855 (commentary only). Books vii and ix are probably spurious, vii being compiled from Hippokratic writings and ix is perhaps by Theophrastos. A book x in some MSS. is perhaps by Straton or a member of his school: Dittmeyer, (*d*) p. vii; W. D. Ross, (1), 12; Ueberweg, (1), i, 369; Zeller, (1), II, ii³, 941.

[1] *Text:* ed. (*a*) Langkavel, Leipzig, 1868 (Teubner), (*b*) A. von Frantzius, Leipzig, 1853 (with German tr.), English trs. (*c*) W. Ogle, 1882, (*d*) *id.* in C, 1912, v, (*e*) A. L. Peck, 1937 (Loeb, with text).

[2] *Text:* ed. (*a*) Jaeger, Leipzig, 1913 (Teubner), (*b*) E. S. Forster, 1937 (Loeb, with English tr.), (*c*) English tr. A. S. L. Farquharson, C, 1912, v. It has been regarded as spurious but is probably genuine: Forster, (*b*), 436; W. D. Ross, (1), 12; Ueberweg, (1), i, 369; Zeller, (1), II, ii, 938.

[3] *Text:* ed. (*a*) E. S. Forster, 1937 (Loeb, with English tr.), (*b*) English tr. A. S. L. Farquharson, C, 1912, v.

[4] *Text:* ed. (*a*) A. L. Peck, 1943 (Loeb, with English tr.), (*b*) English tr., A. Platt, C, 1912, v; (*c*) *Aristoteles fünf Bücher von der Zeugung und Entwickelung der Thiere, Griechisch und Deutsch*, H. Aubert and F. Wimmer, Leipzig, 1860 (text and German tr.). VIII and IX are genuine.

[5] Pliny, viii, 17; Deussen, (1), II, i, 315; Zeller, (1), II, ii, 172.

[6] Athenaios, ix, 58.

[7] Humboldt, (4), ii, 523 f.; Jaeger, (1), 1934, 293; Tarn, CAH, iv, 359.

[8] Deussen, (1), II, ii, 325.

[9] W. Hertz, (1), 1 f., 24 f.; Avicenna called him 'the Vizier of Alexander', Stahr, DBM, i, 321.

[10] V, i, 17, 497*a*.

[11] V, ii, 11, 503*a*.

[12] *Text:* ed. (*a*) F. A. Trendelenburg, Jena, 1833, Berlin, 1877, (*b*) R. H. Hicks, Cambridge, 1907 (with introd., tr. and notes), (*c*) W. D. Ross, Oxford, 1956, (*d*) W. S. Hett, 1935 (Loeb, with tr.), (*e*) Biehl, Leipzig, 1896 (Teubner), (*f*) Apelt, Leipzig, 1911 (Teubner), (*g*) English tr. J. A. Smith, C, 1931, iii, (*h*) W. A. Hammond, (1), with XI, (*j*) French tr., D, 1846, (*k*) *ib.* G. Rodier, 2 vols., Paris, 1900 (crit. by Hicks), (*l*) German tr. E. Rolfes, *Des Aristoteles Schrift über die Seele*, Bonn, 1901. It may not all be by Aristotle.

[13] *Text:* ed. (*a*) Biehl, Leipzig, 1898 (Teubner), (*b*) Hett, 1935 (Loeb, with x and θ, with English trs.), (*c*) W. D. Ross, Oxford, 1955 (revised text, introd., paraphrase, comment.), English trs. (*d*) J. I. Beare and G. R. T. Ross, C, 1931, iii, (*e*) Hammond, (1), (*f*) French tr., D, 1847, (*g*) G. Mugier, Paris, 1953 (Budé), (*h*) German tr. E. Rolfes, *Kleine Naturwissenschaftliche Schriften*, Leipzig, 1924 (with intr. and comment.), (*j*) (i) and (ii) ed. and tr. G. R. T. Ross, Cambridge, 1906; (*k*) vii and viii tr. W. Ogle, 1897 (intr. and comment.). Freudenthal, *Rhein. Mus.*, 1869, xxiv, 81; Hammond, (1), 145. The tracts continue X and introduce VI, and deal mostly with biological and physiological subjects. A fifth pair of phenomena, health and sickness, may have been dealt with in a work on medicine (Ἰατρικαί) mentioned by Diogenes Laertios. A treatise *On Food* (περὶ τροφῆς) (X, ii, 4, 414*b*; XI, iii, ch. 3, 456*b*) does not exist: Hammond, (1), 63, 224. The tract viii contains the only known fragments of Presokratic authors on the subject: *ib.*, 292. It is said to be merely a continuation of XI, vii, since it lacks the usual introduction.

(ii) *On Memory and Recollection* (περὶ μνήμης καὶ ἀναμνήσεως, *de memoria et reminiscentia*).
(iii) *On Sleeping and Waking* (περὶ ὕπνου καὶ ἐγρηγόρσεως, *de somno et vigilia*).
(iv) *On Sleeplessness* (περὶ ἐνυπνίων, *de insomniis*).
(v) *On Divination by Dreams* (περὶ τῆς καθ' ὕπνον μαντικῆς, *de divinatione per somnum*).
(vi) *On Length and Shortness of Life* (περὶ μακροβιότητος καὶ βραχυβιότητος, *de longitudine et brevitate vitæ*).
(vii) *On Youth and Old Age, on Life and Death* (περὶ νεότητος καὶ γήρως περὶ ζωῆς καὶ θανάτου, *de juventute et senectute, de vita et morte*).
(viii) *On Respiration* (περὶ ἀναπνοῆς, *de respiratione*).

XII. *Metaphysics* (τῶν μετὰ τὰ φυσικά, 'after the Physics', from the position of the work in old collections; the name is later) exists in an imperfect text.[1]

XIII. *Fragmenta.*[2]

Several important works are not by Aristotle, although some may be early and, if not partly by him, were compiled by members of his school. These are denoted by Greek numerals:

α'. *Mechanics* (μεχανικά), or perhaps *Mechanical Problems* (μεχανικά προβλήματα),[3] by a member of the Peripatetic School, perhaps Straton, although parts may be by Aristotle.[4] It contains the principle of virtual velocities and good material on the principles of statics.[5]

β'. *On Colours* (περὶ χρωμάτων, *de coloribus*),[6] perhaps by Theophrastos or Straton (Loveday and Forster think not, and Hett says the author is unknown). It is a collection of facts upon which a theory of colour might be founded.[7] It is translated by Goethe in his *Farbenlehre*.[8]

γ'. *On Marvellous Things Heard* (περὶ θαυμάσιων ἀκούσματων; *de mirabilibus auscultationibus*),[9] a collection, by members of the Peripatetic School,

[1] *Text:* ed. (*a*) Christ, Leipzig, 1895 (Teubner), (*b*) Tredennick, 2 vols., 1933–5 (Loeb, with transl.), (*c*) W. D. Ross, 2 vols., Oxford, 1924 (revised text, intr. and comment.); English trs. (*d*) W. D. Ross, C, 1908, viii, (*e*) R. Hope, New York, 1952 (index, 75 pp.). It is quoted by the Greek letter number of the books: *A*, *α*, *B*, *Γ* to *N* (*i.e.* i–xiv); book *α* may be by the Peripatetic philosopher Pasikles of Rhodes, nephew of Eudemos; books xi and xiii may be spurious. Robin, (1), 304.

[2] *Text:* ed. (*a*) V. Rose, Leipzig, 1886 (Teubner), (*b*) Heitz, Paris, 1869 (supplement to B), (*c*) Bekker, A, 1870, v; English tr. Ross, C, 1952, xii.

[3] *Text:* ed. (*a*) Apelt, Leipzig, 1888 (Teubner), (*b*) in B, 1867, iv, 54, (*c*) Hett, in *Minor Works*, 1936, 327–411 (Loeb, with English tr.), (*d*) J. P. van Capelle, Amsterdam, 1812; English tr. E. S. Forster, C, 1913, vi.

[4] Farrington, 1949, ii, 45; Gandz, *Isis*, 1929, xii, 476; Ueberweg, (1), i, 369.

[5] Lewes, 148.

[6] *Text:* ed. (*a*) Prantl, Leipzig, 1881 (Teubner), (*b*) Hett, in *Minor Works*, 1936, 1–45 (Loeb, with English tr.), (*c*) in B, 1854, iii, 643–54; English tr. (*d*) T. Loveday and E. S. Forster, C, 1913, vi, (*e*) German tr. Prantl, *Aristoteles Ueber die Farben, erläutert durch eine Uebersicht über die Farbenlehre der Alten*, Munich, 1849.

[7] E. H. F. Meyer, i, 195; A. E. Taylor, (1), 491; Zeller, (1), II, ii^3, 936.

[8] In *Werke, Naturwiss. Schriften*, Weimar, 1893, II, iii, 1, p. 24 f., who, 56 f. gives Greek and Roman colour names.

[9] *Text:* ed. (*a*) Apelt, Leipzig, 1888 (Teubner), (*b*) Hett, *Minor Works*, 1936, 235–325 (Loeb, with English tr.), (*c*) in B, iv, 75, (*d*) A. Westermann, (1), (*e*) J. Beckmann, Göttingen, 1786 (from Vienna MS., Latin tr., and notes), (*f*) English tr. L. D. Dowdall, C, 1913, vi.

of random notes. It consists of: (i) excerpts from biological works by Theophrastos and others, (ii) interpolated extracts from the historical work of Timaios of Tauromenium (*c.* 350–260 B.C.), through Poseidonios, (iii) an appendix (chs. 152–78), at the earliest 3 and perhaps 6 cent. A.D. The bulk is of A.D. 117–38. It was attributed to Aristotle because the beginning is taken from V.[1]

δ′. *Problems* (*προβλήματα, problemata*), 36 sections.[2] Aristotle himself[3] refers to them, and some parts are probably genuine; the present collection includes fragments from his biological works, parts from the Hippokratic collection, and minor works of Theophrastos and Straton; the present form was not completed till the 6–7 cents. A.D.[4]

ε′. *On the Universe* (*περὶ κόσμου πρὸς Ἀλέξανδρον; de mundo*)[5] recognised as spurious by Proklos (A.D. 410–85), was probably compiled in 50 B.C.–A.D. 100, perhaps *c.* A.D. 100, and contains Platonic, Peripatetic, and Stoic elements, the latter (probably from Poseidonios) including the theory of sympathy, the idea that cold is a characteristic property of air, and the doctrine of pneuma. The ether is separated from the other elements and called (as in Aristotle) a fifth element. Herakleitos is quoted for four colours (black, white, yellow, and red), tones, elements, etc.[6] There is an Arabic translation in the Bodleian, and the work was used by Arabic authors.[7]

ζ′. *On Plants* (*περὶ φυτῶν, de plantis*),[8] known only as a Latin translation from Arabic made by the Englishman Alfred of Sarashel (*c.* A.D. 1250), the Greek text being a Renaissance translation of this. It shows Peripatetic

[1] A. Brinkmann, *Rhein. Mus.*, 1916, lxxi, 159; Gerke, PW, ii, 1048; W. Headlam, *Class. Rev.*, 1905, xix, 439; K. Praechter, *Philologus*, 1905, lxiv, 386; Reinach, *Rev. de Philol.*, 1911, xxxv, 34; W. D. Ross, (1), 12; H. Schrader, *Jahrb. klass. Philol.*, 1868, xcvii, 217; Stahr, (1), 332; Susemihl, i, 478; Ueberweg, (1), i, 369; Wilamowitz-Moellendorff, *Hermes*, 1919, liv, 46 (68).

[2] *Text:* ed. (*a*) C. E. Ruelle, Knoellinger, and Klek, Leipzig, 1922 (Teubner), (*b*) Müller, in B, 1867, iv, 108 (*Problemata inedita*, 291); English tr. E. S. Forster, C, 1927, vii; French tr., D, 2 vols., 1891 (says in i, 75, genuine). Alexander of Aphrodisias also wrote a *Problemata*: in Ideler, (1), i, 3–80 (*προβλημάτων*), with a work on fevers (*περὶ πυρετου*), 81–106; Wellmann, in Puschmann, (1), i, 482, says both are spurious and belong to the Pneumatic School after the 2 cent. A.D.

[3] III, ii, 6, 363*a*.

[4] Diels, *Hermes*, 1905, xl, 301; Forster, in C, 1927, vii, pref. vii; *id.*, *Isis*, 1918, xi, 155; M. Neuburger, (1), i, 171; Prantl, *Abhl. Akad. Munich, Philos.-philol. Cl.*, 1852, vi, 339–77; V. Rose, (1), 215; Stahr, (1), 332; Stumpf, *Abhl. Akad. Berlin*, 1896, no. 3 (musical parts 1–2 cents. A.D.).

[5] *Texts:* (*a*) B, 1854, iii, 627–42, (*b*) Lorimer, Paris, 1933; English tr. (*c*) G. S. Forster, C, 1931, iii; French tr. (*d*) Festugiere, (1), ii 460-77, 512 (eclectic); German tr. (*e*) W. Capelle, *Die Schrift von der Welt*, Jena, 1907.

[6] W. Capelle, *N. Jahrb. klass. Alt.*, 1905, xv, 529–68; Gerke, PW, i, 2167; H. A. A. Kennedy, 8; W. S. Lorimer, The Text Tradition of pseudo-Aristotle De Mundo (*St. Andrews Univ. Publ.* 18), Oxford, 1924; *id.*, Some Notes on the Text of pseudo-Aristotle De Mundo (*St. Andrews Univ. Publ.* 21), Oxford, 1925; W. D. Ross, (1), 11; Stahr, (1), 329; Susemihl, ii, 138, 326 f.; Ueberweg, (1), i, 369, 557; Zeller, (1), III, i³, 631.

[7] De Goeje, (1), 297.

[8] *Texts:* ed. (*a*) Apelt, Leipzig, 1888 (Teubner), (*b*) Hett, *Minor Works*, 1936, 139–233 (Loeb, with English tr.), (*c*) B, 1857, iv, 16–44; English tr. E. S. Forster, C, 1913, vi. A spurious *De pomo* (the apple) in Arabic, which was first mentioned in the 10 cent. by the Brethren of Purity, is known in Hebrew and Latin (made by Manfred, son of Frederick II) and was very popular in Europe: Aristotle on his death-bed is said to hold an apple, the smell of which kept him alive until he had finished addressing his disciples: Fabricius, (1) (*b*), iii, 281; Dieterici, (1), 1876, i, 105; W. Hertz, (1), 371–97.

influence. The views on sex in plants anticipate modern ones.[1] Some treatment of plants is given in VI, IX, and X. Plants draw nutriment from the earth, the root corresponding with the head of an animal, the leaves serve only for protection. They have no excretory organs, since the food was prepared in the earth. They have a kind of soul, distributed over the whole organism, since they are propagated by cuttings.[2]

The beginning of book (ii) is a general digression on coction (πέψις), used later in the work; book (i) often quotes Empedokles. The *Meteorology* is quoted by name[3] for the origins of streams and rivers. Aristotle[4] refers to a book on plants by himself, extant in fragments.[5]

η′. *Minor Works* by the Peripatetic School[6] are:

(i) *On Things Heard* (περὶ ἀκουστῶν, *de audibilibus*), perhaps by Straton.

(ii) *Physiognomics* (περὶ φυσιογνωμικά, *de physiognomonica*), perhaps 3 cent. B.C. or 2 cent. A.D. from two older fragments.

(iii) *On Indivisible Lines* (περὶ ἀτόμων γραμμῶν, *de lineis insecabilibus*), perhaps by Theophrastos or Straton.

(iv) *On the Situation and Names of Winds* (ἀνέμων θέσεις καὶ προσηγορίαι, *de ventorum situ et cognomina*), perhaps extracts from a work by Theophrastos.

θ′. *On Spirit* (περὶ πνέυματος, *de spiritu*),[7] perhaps by Theophrastos or Straton, says pneuma is distributed from the heart, which is the organ of sensation (not the flesh, as Aristotle taught), and discusses its distribution in the sinews and nerves.[8]

κ′. *Lost Works* attributed to Aristotle are: (i) A medical work on remedies (*De Adjutoriis*), giving 'definitions' of diseases.[9] (ii) Problems of Demokritos (προβλήματα ἐκ τῶν Δημοκρίτου, πρὸς Δημόκριτον). (iii) On mixtion (περὶ μίξεων). (iv) On metals (or mines) (περὶ μετάλλων). (v) On theology or the mysteries of the Egyptian philosophers (in Arabic).[10]

General

Aristotle frequently makes statements which seem to us true and modern. A man 'knows' when he can teach.[11] In considering a problem the difficulties and the treatment of it by others should first be dealt with; no one can untie a knot which he cannot see, and he who starts research without first stating his

[1] Bouyges, *Isis*, 1926, viii, 531; Burnet, (1), 242; Jourdain, (1), 173; E. H. F. Meyer, i, 323; iii, 144; Senn, *Philologus*, 1930, lxxxv, 113; Ueberweg, (1), i, 369. For sex in plants see Herodotos, i, 195 (palms); Ktesias, in Lassen, i, 49; ii, 641 (reeds); Pliny, xvi, 6 (trees); Ausfeld, 94, 186; sex in stones, Pliny, xxxvi, 25 f.; Blümmer, (1), iii, 257, 263; Krause, 15, 45, 57, 69, 83; Nies, PW, i, 704, 2416; Rossbach, PW, vii, 1108; Seidel, MGM, vi, 259; incense, Hippokrates, tr. Fuchs, 1900, iii, 464.

[2] Rolfes, (2), 222–3, 242. [3] ζ′, ii, 2, 822*b*. [4] IX, i, 23, 731*a*.

[5] Wimmer, *Phytologiæ Aristotelicæ Fragmenta*, Breslau, 1838; Hoefer, (3), 1872, 50.

[6] *Texts:* All ed. (*a*) Apelt, Leipzig, 1888 (Teubner), (*b*) W. S. Hett, *Minor Works*, 1935 (Loeb, with English tr.: i 47–79, ii 81–137, iii 413–47, iv 449–57); English tr., (*c*) C, 1915, vi (i and ii by T. Loveday and E. S. Forster, iii by H. H. Joachim, iv by E. S. Forster); Ueberweg, (1), i, 369.

[7] *Text:* ed. (*a*) Hett, 1935 (with X etc., English tr., Loeb); English tr. (*b*) J. F. Dobson, C, 1913, iii.

[8] Jaeger, *Hermes*, 1913, xlviii, 29 (58); Zeller, (1), II, ii³, 937.

[9] Cælius Aurelianus, *Morb. Acut.*, II, xiii, 87, ed. Drabkin, Chicago, 1950, 180.

[10] Brandis, II, ii, 85, 90, 91, 99, 100, 120. [11] XII, A, i, 981*b*.

problems does not know where he is going and cannot see ahead.[1] In some cases the facts have not been sufficiently ascertained, and if in future they are ascertained, more credence must be given to the direct evidence of the senses than to theories, and to theories if conclusions from them agree with observation.[2] The aim of science is to explain what is observed, without preconceived ideas, since human opinions have changed and older ones have come to be accepted again; not everything can be explained, although we are convinced that everything follows natural laws.[3] Knowledge comes from experience and its extent is determined by the extent and accuracy of observations.[4] It is absurd to try to explain the whole universe on the basis of a few things known for the earth,[5] which is only a small thing, far smaller than some stars.[6] 'Error seems to be natural to living creatures, and the soul spends more time in it.'[7]

Aristotle's method is based on two axioms: (i) Nature does nothing in vain (see p. 84), (ii) a problem must be studied from all sides, not one side only; experience furnishes the material for conversion into general principles.[8] Scientific consideration must be limited to what is valid universally (καθ' ὅλου, 'catholic'), or at least for the most part (ἐπὶ τὸ πολύ); there may be 'accidental' elements in particular cases, for which no theory is possible.[9] Aristotle laid more stress on empiricism than Plato,[10] and was more interested in chemistry and biology and less in mathematics. He had an idea of 'physical dimensions' of magnitudes; things of different natures cannot be compared.[11]

Plato's *ideas* are unnecessary duplications of things, they cannot be substantial, and cannot contain the power of motion and change.[12] He criticised the Pythagorean views on the One and on matter,[13] and the atomic theory of Leukippos and Demokritos by a supposed proof of the impossibility of a vacuum. If a body occupies any position there must be two spaces, that filled by the body and the empty space, which is absurd.[14] In empty space there would be no 'up and down' directions in which, however, the elements naturally move,[15] and in empty space all bodies, heavy and light, would fall equally fast, which is impossible.[16] He also has arguments based on ideas of infinity, limits, the infinite divisibility of lines, etc., sometimes confounding mathematical with physical divisibility.[17] The atomists do not explain how a specific substance such as gold can be produced by modes of arrangement of atoms.[18] Nevertheless, particles of organic materials such as bone must have an upper and lower limit of size, outside which they cease to exist.[19] He resolved Zeno's paradox which says: it is impossible to traverse an infinite space in a

[1] XII, *A*, 2, 982*b*; B, 1, 994*a*–*b*. [2] IX, iii, 10, 760*b*.
[3] II, iii, 7, 306*a*; III, i, 1, 3, 339*a*–*b*.
[4] XII, *A*, 1, 981*a*; see also II, ii, 14, 297*b*; III, i, 3, 339*b*; ii, 5, 362*b*; iv, 1, 378*b*.
[5] XII, *Γ* (iv), 5, 1010*a*. [6] II, ii, 14, 297*b*; III, i, 3, 339*a*. [7] X, iii, 3, 427*b*.
[8] Stephanides, *Isis*, 1920, iii, 430; Zeller, (1), II, ii³, 172.
[9] Windelband, (1), 143. [10] Zeller, (2), 200. [11] XII, *I* (x), 1, 1053*a*.
[12] XII, *M*, 4, 1078*b*; Zeller, (1), II, ii, 292–303.
[13] XII, *N*, 1 f., 1087*a* f. [14] I, iv, 8, 214*b*. [15] II, iv, 1, 2, 308*a*–310*a*.
[16] I, iv, 8, 214*b*: ἰσοταχῆ ἄρα πάντ' ἔσται. ἀλλ' ἀδύνατον; for other arguments, see II, i, 7, 275*b*; Brandis, II, ii, 10–30; Lasswitz, (1), i, 103 f.; Zeller, (1), II, ii³, 286, 396, 400, 406, 408 f.
[17] I, i, 2; iii, 5, 7; iv, 7–9; vi, 1, 9; II, i, 7; iii, 6; IV, i, 2; XII, i, 4; η', iii.
[18] II, i, 7, 276*a*. [19] I, i, 4, 188*a*.

finite time, but it is possible to traverse an infinitely divided space, since a finite time is also infinitely divisible.[1] Although matter is continuous there can be movement without a void, as in vortex motions in liquids; matter can fill space with different degrees of density and there is no limit to its tenuity.[2] Since he recognised no empty space, Aristotle defined the 'place (τόπος)' of a body as the *interior* limit of a surrounding body.[3] The place of a liquid is the *inner* surface of its container. Theophrastos differed from him on this point.

Aristotle had some special failings. He neglected to verify his 'facts', and he generalised too much from too few data.[4] As Hoefer[5] said: 'la philosophie ancienne, la science des Grecs, était une synthèse prematurée.'

Aristotle, a pupil of Plato, began as a Platonist. His early works are pessimistic dialogues of a Platonic character which are lost except for fragments. *Eudemos* (Εὔδημος ἢ περὶ ψυχῆς) argues for the immortality of the soul on Platonic lines, and expounds a dualism of soul and body even sharper than Plato's and quite unlike Aristotle's later psychology. *On Philosophy* (περὶ φιλοσοφίας) (347–5 B.C. ?) is different in tone and speaks with assurance; it rejects the theory of ideas and their relation to numbers.[6] Platonists[7] usually charge Aristotle with misunderstanding Plato, but his outlook was more scientific.[8]

Matter

All previous writers on physics, Aristotle says, admitted the existence of opposites (τἀναντια, *i.e.* τὰ ἐναντια), such as full and empty, hot and cold, dry and moist, dense and rare, love and hate — even Demokritos had being and not-being. Every thing comes into being from its opposite, and every thing which passes away is resolved into its opposite, or an intermediate state which is also derived from opposites. In all coming into being there must be a certain underlying substrate which persists and serves as a support, and is not susceptible of opposites, since then it would not subsist.[9]

All things or substances which have an absolute existence come from an anterior subject. *Coming into being* (γένεσις) is of five kinds: (i) *transformation* (μετασχηματίσει), as a statue from bronze; (ii) *accretion* (προσθέσει), as the growth of plants and animals; (iii) *reduction* (ἀφαιρέσει), as a statue comes from a block of marble; (iv) *combination* (συνθέσει), as building a house; and (v) *qualitative alteration* (ἀλλοιώσει), as when the substance is changed (οἷον τὰ τρεπόμενα κατὰ τὴν ὕλην) (ἀλλοίωσις is always a passive quality, τὸ ποιόν).[10]

For the underlying substrate (ὑπάρχη), permanent in all changes of material bodies, Aristotle uses various names: essence (οὐσία), first one (πρώτος ὄν),

[1] I, vi, 9, 239*b*. [2] I, iv, 6, 213*a*–214*b*; Ross, (1), 8.
[3] I, iv, 4–5, 210*b*–212*b*; v, 3, 227*a*; vi, 1, 231*b*; Rolfes, (2), 106, 115; Ueberweg, (1), i, 384.
[4] F. Bacon, *Novum Organum*, I, aphor. lxiii, *Works*, 1857, i, 174; Lee, in III, (*e*), xxvi–xxviii; Lewes, 52–121; Whewell, (1), i, 54 f., 345.
[5] (1), i, 103–5.
[6] XIII; *Aristotelis Dialogorum Fragmenta . . . selegit*, R. Walzer, Florence, 1834; Festugière, (1), 1949, ii, 219–59, and bibl.
[7] Archer-Hind, 105, 175, 179, 184, 190, 202, 229, 236, 244, 259, 287, 312; Jowett, 1871, ii, 522*.
[8] Zeller, (1), II, ii[3], 49, 170. [9] I, i, 5, 188*a*–*b*. [10] I, i, 7, 190*a*; IV, i, 1, 314*a*f.

first essence (πρώτη οὐσία).[1] Matter (ὕλη) is something from which (ἐξ οὗ) something comes into being, and is a component of the thing produced (ἐξ οὗ ἐνυπάρχοντος).[2] It is an internal constitutive principle and not a mere accident (οὗ γίγνεταί τι ἐνυπάρχοντος μὴ κατὰ συμβεβηκός)'[3] Matter is not evil; individual things and matter itself are striving to 'become immortal as far as they can'; they largely fail, due to matter itself, or to necessity, but this is indifferent to good or evil.[4]

Material changes presuppose a substrate (ὑποκειμένον) which can take on the changes. Everything which is (σύνολον) comprises the substance (οὐσία, ὕλη) and the form (εἶδος, μορφή, λόγος, sometimes οὐσία) in which this clothes itself.[5] A thing cannot come into being from Being, since this exists already; neither from Not-Being, since nothing can come from nothing. Things come into being (become actual) from something intermediate between Being and Not-Being, which has the possibility (potentiality) of becoming some thing, but is not that thing actually.[6] This view is the special contribution of Aristotle, and removed a host of difficulties and contradictions in earlier systems.[7]

Stobaios (*c.* A.D. 450) says both Plato and Aristotle taught that 'form (εἶδος) alone separated from matter is incorporeal (ἀσώματον), and matter (ὕλη) alone when the form is separated from it is not a body (σῶμα); matter and form together make up the substance (ὑπόστασιν) of the body'.[8] Aristotle first consistently used ὕλη as a technical name for 'matter'; its original meaning was 'wood' (*sylva*) or 'timber'.[9] In Latin, *materia* meant both 'matter' (Cicero, Lucretius) and 'wood'; in Plautus (d. 184 B.C.) *materiarius* is a 'timber-merchant'.[10]

Aristotle used different names for 'form', sometimes with different meanings: μορφή is usually the sensible shape of a body, εἶδος its 'intelligible structure', and λόγος (formula, or definition) and τὸ τί ἦν εἶναι (what it was to be so-and-so) are synonymous with εἶδος.[11] The usual names for matter and form are ὕλη and εἶδος. A particular thing composed of matter and form is 'this one here (τόδε τι, *hoc aliquid*)'; its essential form is 'the one which makes it truly what it is (τὸ τί ἦν εἶναι, *quod quid erat esse*)'; the real existence of the material is 'that which is it (τὸ τί ἐστιν, *quod quid est*, *quidditas*)' or its 'quiddity'. The matter (ὕλη) is never a τόδε τι, and change occurs only in things composed of matter and form.[12]

The expression πρώτη ὕλη (*proté hulé*), 'primary matter', is very rarely used

[1] Zeller, II, ii, 305 f., 345.
[2] I, i, 9, 192*a*; ii, 3, 194*b*; XII, *A*, 5, 986*b*; Baeumker, 222, for several refs. to A.
[3] I, i, 9, 192*a*; Brandis, (1), II, ii, 693; G. Engel, Über die Bedeutung der ὕλη bei Aristoteles, *Rhein. Mus.*, 1850, vii, 391–418; Kaufmann, 28; Rolfes, (2), 57.
[4] Ross, (1), 178; Zeller, (1), II, ii³, 338.
[5] Baeumker, 214 f., 241, 262, 282; Kaufmann, 34; Stahr, (1), 335; Zeller, (1), II, ii³, 314–15, 343, 345.
[6] I, i, 7–8, 190*a*–191*b*; ii, 1, 192*b*; Windelband, (1), 142–3; Zeller, (1), II, ii³, 313 f.
[7] Stahr, (1), 335; Zeller, (1), II, ii, 306 f., 312, 343 f.
[8] Stobaios, *Eklog. Phys.*, i, 14–15; Cudworth, i, 87.
[9] Cudworth, 124, 126; Rolfes, (1), 50; A. E. Taylor, (1), 266.
[10] Gummerus, PW, ix, 144; LS, 1118; 'Madeira' is the Portuguese name of the island called 'Isola de legname' by its Italian discoverers.
[11] N. Hartmann, *Abhl. Akad. Berlin, Phil.-hist. Kl.*, 1948, no. 8; Ross, (1), 73 f.
[12] Zeller, (1), II, ii³, 347.

by Aristotle.[1] In a few cases it is a material substance.[2] When united with a pair of contraries (see p. 79) it forms one of the four elements or 'simple bodies'.[3] It is not so much matter completely destitute of form[4] but matter having the minimum of form.[5] It is undefined (*ἀόριστον*) or amorphous.[6] The name *πρώτη ὕλη* is sometimes used for the simplest component, as water of all fusible things, or bronze of statues.[7] 'Ultimate matter (*ἐσχάτη ὕλη*)' is the result of the analysis of a body rather than its synthesis.[8]

Aristotle often uses *οὐσία* (*ousia*) for a combination of matter (*ὕλη*) and form (*εἶδος*),[9] but sometimes in three senses: form, matter, and the two combined, and his meaning of 'matter' is somewhat vacillating.[10] In some cases matter and form are supposed to exist together from the beginning, and matter is shaped *internally* by form, as in the growth of living beings or the creative faculty in man;[11] in other cases matter is a 'common substrate (*κοινὸν ὑποκείμενον*)' existing by itself and form is impressed upon it as by a stamp upon wax,[12] but Aristotle does not favour this mechanical and exterior process and says that matter and form attract one another like opposite sexes.[13] Once[14] he says 'one must suppose as many distinct species of matter as there are bodies (*εἰ μὲν γὰρ μία ὕλη πάντων*)'.

Matter is imperishable and uncreated:[15] *ἄφθαρτον καὶ ἀγένητον ἀνάγκη αὐτὴν εἶναι. εἴτε γὰρ ἐγιγνετο, ὑποκεισθαί τι δεῖ πρῶτον, τὸ ἐξ οὗ ἐνυπάρχοντος . . . εἴτε φθείρεται, εἰς τοῦτο ἀφίξεται ἔσχατον.* The meaning is that if matter (*ὕλη*) had come to be, something primary must have existed before it and persist in it, whilst this is what matter itself is; whilst if it ceased to be it would pass ultimately into this other thing which is the same as itself, and hence (as it still exists) will have ceased to be before ceasing to be. Hence it neither comes into being nor ceases to be.[16]

Motion and Change

The essential nature (*οὐσία*) of a thing is given in the primary matter (*ὕλη*) only potentially, or exists only in 'power (*δύναμις, potentia*)'; it exists in reality or in 'act (*ἐνεργεία, actus*)' by the taking on form (*εἶδος*), and this process is change or motion. This self-realisation of the essence in phenomena was given

[1] Ross, (1), 73, 168.
[2] XII, *Z* (vii), 10, 1035*b*; *H* (viii), 4, 1044*a*; *Λ* (xii), 2–3, 1069*b*–1070*a*; Baeumker, 241, 259.
[3] IV, ii, 1, 329*a*.
[4] Baeumker, 223, 236, 261.
[5] XII, ix, 7, 1049*a*; Lasswitz, (1), i, 99; Ross, (2), ii, 256; Zeller, (1), II, ii³, 320 f.
[6] I, iv, 2, 209*b*, ref. to Plato, *Tim.*, 52A; Baeumker, 238.
[7] XII, *Δ*, 4, 1015*a*; 24, 1032*a*: 'all things that can be melted come out of water.'
[8] XII, *H* (viii), 3, 6, 1043*b*, 1045*a*; I, ii, 1, 193*a*; Baeumker, 212, 214, 241; Ueberweg, (2), i, 157; Windelband, (1), 144; Zeller, (1), II, ii³, 313 f., 320, 348.
[9] X, ii, 1, 2, 412*a*, 414*a*; XII, *Z* (vii), 3, 10, 1029*a*, 1035*a*; *H* (viii), 2, 1043*a*; *Λ* (xii), 3, 1072*a*; Baeumker, 258; Gilbert, 183; Kaufmann, 33; Rolfes, (1), 51.
[10] X, ii, 2, 414*a*; Baeumker, 254, 257–8.
[11] I, i, 7, 190*a*.
[12] I, i, 9, 192*a*; ii, 1, 193*a*; Baeumker, 210, 223, 241, 259; Gilbert, 183; Windelband, (1), 141: Zeller, (1), II, ii³, 321, 490.
[13] I, i, 9, 192*a*; Baeumker, 263; Zeller, (1), II, ii³, 347–8.
[14] II, iv, 5, 312*b*.
[15] I, i, 9, 192*a*; Saint-Hilaire, D, *Physique*, i, 494, says 'this must be taken in a restricted sense only', and Zeller, (1), II, ii³, 317, that 'the passage is obscure'.
[16] See also II, iii, 301*b*: *ὅτι δ' οὔτε πάντων ἐστὶ γένεσις οὔθ' ἁπλῶς οὐθενός*: 'it is plain that there cannot be generation either of everything or, in an absolute sense, of anything': Stocks. C. ii, 301*b*. 34–5.

by Aristotle a new name, *entelechy* (ἐντελέχεια, from τὸ ἐντελὲς ἔχον, the complete possession).[1] The distinction between 'power' and 'act' was perhaps derived from natural phenomena: the 'form' determines that like things produce like: olive trees produce olive trees, etc.[2] When Aristotle uses 'energia' and 'entelechia' together,[3] the first means 'actuality (*actus*)' and the second 'fulfilment (*perfectio*)'. Aristotelians found it difficult to translate ἐντελέχεια; Hermolaus Barbarus (1453–91) used *perfectihabia*; Cicero used it in Greek and Tertullian first used *entelechia* as a Latin word.[4] Other translations were 'very act (*ipse cursus actiones*)', 'first act (*primus actus*; also used for a non-operating form, Aristotle's 'first entelechy'), or 'virtue (*efficacia*)'. *Entelechia* is more ultimate than *energia*; *energia* is the process or motion (in the widest sense) in which the potential becomes the actual, *entelechia* is the finished state, the perfect realisation of all that any being or potentiality is capable of becoming. Although an object exists potentially before the change, another individual precedes it in actuality, as an organism proceeds from seeds, but the seeds come from another individual; the egg is not earlier than the hen.

Aristotle uses the phrase 'as being', or 'as such' or 'in so far as (*qua*)' for some essential property: 'light is the act of what is lucid as being lucid'; a torch can move as well as shine but its motion is not its act 'as being' a lucid body. Motion is the actuality of the potential as such.[5] All kinds of motion are change (μεταβολή) of one into another,[6] and there are three categories of motion: quantity, quality, and place.[7] Plato[8] had said there are two forms (εἴδη) of motion: (1) from place to place (φορά), and (2) from state to state (ἀλλοίωσις), and that qualities (ποιότητες) are perpetual processes going on between what acts and what is acted upon, so that in the moment when it is being named the quality is gone.

In his discussion of mechanical motion Aristotle recognised the two vectors AB and BA.[9] He says motion can neither come into being from nothing nor perish into nothing (which is correct), and that everything in motion is moved by something (which is one of his fundamental errors).[10] Everything remains at rest unless it is compelled to move.[11] Since there is no vacuum, things act upon one another only by contact, which need not be immediate but can be through a mechanism, as in machinery, or the propagation of sound through the air as a medium until it reaches the ear-drum.[12] The contact must continue during the whole of the motion[13] and is necessary even if the mover is immaterial, e.g. thought.[14] There always has been, and always will be, motion.[15]

[1] Diels, *Z. f. vergleich. Sprachenf.*, 1916, xlvii, 192 (200); Rolfes, (1), 82; Stahr, (1), 337; Stephanides, *Isis*, 1925, vii, 474; Windelband, (1), 139; Zeller, (1), II, ii³, 318, 321 f., 350. Aristotle mostly uses the words 'in power (δυνάμει)' and 'in act (ἐνεργείᾳ)', in the dative.

[2] Baeumker, 249, 259, 286.

[3] XII, Θ (ix), 3, 1047*a*.

[4] Hermolaus Barbarus, *Compendivm Scientiae Naturalis ex Aristotele*, Paris, 1547 (CUL Dd*. 5. 19³ (F)); J. N. Johnson, *The Life of Thomas Linacre*, ed. R. Graves, 1835, 127; Waszink, 387; Whewell, (1), i, 43.

[5] I, iii, 1–2, 201–2*a*: ἡ τοῦ δυνάμει ὄντος ἐντελέχεια, ᾗ τοιοῦτον, κίνησις ἐστιν.

[6] I, v, 1, 225*a*.

[7] I, ii, 1, 192*b*; v, 1, 225*b*; vii, 2, 243*a*; viii, 7, 260*a*; II, iv, 3, 310*a*.

[8] *Theaitetos*, 181*d*; *Works*, i, 386.

[9] I, iii, 3, 202*b*.

[10] I, vii, 1–3, 241*b*–248*a*; viii, 1, 250*b*–253*a*, viii, 4–6, 254*b*–259*a*; XII, xii, 6, 1071*b*.

[11] I, viii, 7, 260*a*–*b*.

[12] IV, i, 6–7, 322*b*–324*a*; X, iii, 12, 434*b*; δ′, xxxii, 13, 961*b*.

[13] I, iii, 2, 202*a*; vii, 2, 244*b*; IX, ii, 1, 734*a*; XII, Δ, 3, 1014*b*; Prantl, (2), *a*, i, 487.

[14] Windelband, (1), (1), 145; Zeller, (1), II, ii³, 356, 377.

[15] I, viii, 1–4, 250*b*.

Aristotle's discussion of the lever[1] shows a clear appreciation of the principle of work or of virtual velocities. Existences include: (i) what is always moved, (ii) what both moves and is moved;[2] hence there must be a third case (*tertium quid*), (iii) that which moves but is not moved, the unmoved mover, the first mover, one and eternal, which is God, located at the circumference of the universe.[3]

When anything is produced, that from which it is produced disappears by 'privation (στέρησις)', and from this point of view there are three principles, or sensible things: (i) a *form* (εἶδος), such as heat, (ii) a *privation* (στέρησις), such as cold, and (iii) a *matter* (ὕλη), which is potentially these perceptible bodies.[4] Cold may be regarded as a privation of heat but it is a real entity, although it exists, as is said, κατὰ συμβεβηκός (*kata sumbebekos*, *per accidens*) rather than καθ'αὑτὸ (*kath'auto*, *per se*). Only things which 'are' in the fullest sense substances (οὐσία) have independent existences; other things are 'attributes (συμβεβηκότα)' of them and exist only when predicated of a 'subject (ὑποκείμενον)', which is a substance.[5]

Steresis is lack of form or a 'feeling of want for form', a transition state between potentiality and actuality, and the process of becoming actual is a sort of evolution.[6] Thus, privation is not a mere negation but is an 'accident' of matter. If it is taken to be absence of form, then there are only two principles, matter and form. Substance and form produce a thing, but form can be only one of two contraries, and as only one of these two can exist at any moment there must be a third principle, privation, to account for the contrary which is absent, and so prevent the occurrence of the other form.

The primary matter was created by God.[7] It is practically the same as the 'space' in Plato,[8] but Aristotle[9] objects that Plato had made it a 'nothing (μὴ ὄν)', as if something 'of itself (ἁπλῶς)' could come from nothing, and he had also overlooked *steresis* (στέρησις). Aristotle answered the old objection that 'nothing can come from nothing' by saying that something *can* come from nothing 'derivatively (μὴ ἁπλῶς)' but not 'directly (ἁπλῶς, *simpliciter*, *secundum quid*)'. It cannot be postulated that primary matter '*either* is *or* is not' since it can be both, one not excluding the other.[10] Privation makes matter a non-being *per accidens* and becoming occurs from a being which in one sense is a non-being.[11]

A certain form requires a certain matter and cannot accept any other: 'that which possesses the actuality will not produce [the article] out of any casual [material] (οὔτε τὸ τὴν ἐνέργειαν ἔχον ποιήσει ἐκ τοῦ τυχόντος).'[12] The material of a chair is wood and of a statue bronze, and the nature of a thing is

[1] α', 1–3, 847*b*–850*b*.
[2] XII, xii, 6–7, 1080*a*–1082*a*; I, iii, 202*a*; vii, 1, 241*b*–245*a*; IV, i, 3, 7, 318*a*, 324*a*; ii, 10, 336*b*.
[3] I, vii, 1, 242*a*; viii, 6, 258*b*–259*b*; II, ii, 3, 286*a*; Rolfes, (2), 132; Zeller, (1), II, ii³, 388.
[4] XII, *Λ* (xii), 4, 1070*b*.
[5] I, i, 7, 190*a*–*b*; 8, 191*b*; Brandis, II, ii, 697 f., 716 f.; Hardie and Gaye, C, ii, 190*a*; Rolfes, (2), 55.
[6] Stahr, (1), 334; Zeller, (1), II, ii³, 393.
[7] XII, x, 2, 1060*a*; xi, 8, 1073*a* (in B); Rolfes, (2), 58.
[8] *Tim.*, 48D–52E.
[9] I, i, 9, 192*a*; Rolfes, (1), 59.
[10] I, i, 7, 191*b*; Rolfes, (1), 60 f.
[11] I, i, 9, 192*a*; Baeumker, 215 f.
[12] IX, ii, 6, 743*a*; Baeumker, 259; Robin, (1), 286.

'what is in each thing as its first (εἶναι τὸ πρῶτον ἐνυπάρχον)';[1] everything has some material of its own, as of bile the bitter, or something of the sort, which comes from bile when it is analysed into its primary material (εἰς τὴν πρώτην ὕλην τὴν χολήν). The material must be different for different objects (ὄντα), for no one can make a saw out of wood or wool.[2] 'Nature (φύσις) is the primary material of which an artefact is made, and cannot in its raw state be transformed by its own power, as bronze of statues or utensils, or wood of wooden objects, etc., for in each of these things the primary material is preserved.'[3] 'By matter (ὕλη) I mean that which is, in itself (καθ' αὐτὴν), not a particular thing or a quantity or anything else by which things are defined', but is 'a something of which each of these is predicated'.[4] We are now warming up for an appreciation of our subject.

Nature

Nature (φύσις) is the principle and cause of motion and rest 'in itself (ἐν αὐτῷ)'; it differs from art in acting from within and contains motion in itself;[5] it is the generation of growing things (from φύειν) and an inherent something out of which (ἐξ οὗ) a thing begins to grow.[6]

Aristotle distinguishes between 'fate (τύχη, *fortuna*)', concerned in human affairs, and 'chance (αὐτόματον, *casus*)' which is concerned in nature; they had been called causes but he made them parts of the efficient cause.[7] 'God and Nature create nothing in vain (ὁ δὲ θεὸς καὶ ἡ φύσις οὐδὲν μάτην ποιοῦσιν).'[8] He distinguished absolute (ἁπλῶς) and conditional (ἐξ ὑποθέσεως) necessity; the first when the existence of a material object (material cause) and its nature, or the nature of the movement set up by a moving cause, *must* produce a result; the second as determined by the nature of the final cause, e.g. an axe used to split wood must be hard and sharp and hence of necessity iron or bronze must compose it.[9] Nature's aim may be thwarted by imperfection (πήρωμα) or mutilation (ἀναπηρία) in which the innate nature (φύσις) cannot reach completeness (τέλος) because the material is imperfect, or too many principles impede the natural processes of generation and dissolution (διά τε τὴν τῆς ὕλης ἀοριστίαν καὶ διὰ τὸ γίνεσθαι πολλὰς ἀρχάς, αἳ τὰς γενέσεις τὰς κατὰ φύσιν καὶ τὰς φθορὰς ἐμποδίζουσαι πολλάκις αἴτιαι τῶν παρὰ φύσιν συμπιπτόντων εἰσίν),[10] an idea used by the later alchemists to explain the formation of imperfect metals in the earth. The nature (φύσις) is in the thing itself (ἐν αὐτῷ) as a principle of motion.[11]

Aristotle is often vague; things happen in a particular way because 'it is their nature', or 'it is better' for them to do so; it seems 'most natural' to explain

1 I, ii, 1, 193*a*. 2 XII, viii, 4, 1044*a*.
3 XII, v, 4, 1014*b*–1015*a*; viii, 6, 1045*b* (proximate matter, ἔσχατη ὕλη); ix, 7, 1049*a*: a thing is not 'a something else (τόδε)', but 'of something else (τόδε τι)'.
4 XII, Z (vii), 3, 1029*a*.
5 I, ii, 1–2, 192*b*–194*a*; 8–9, 198*b*–200*b*; iii, 1, 200*b*; Rolfes, (2), 65; Zeller, (1), II, ii^3, 385, 424–7.
6 XII, *Δ*, 3, 1014*b*.
7 I, ii, 8, 198*b*; II, ii, 8, 289*b*; Rolfes, (1), 71–85; Zeller, (1), II, ii^3, 330–6.
8 II, i, 4, 271*a*; IX, ii, 6, 744*a*; v, 8, 789*b*; VI, ii, 13, 658*a*.
9 Peck, in IX (*a*), xlii f. 10 IX, iv, 10, 778*a*. 11 II, iii, 2, 301*b*.

first the common properties of things and then their particular properties;[1] bodies move up or down 'by nature (κατὰ φύσιν)'.[2] This idea is still common among the uneducated — old paint has 'lost its nature'. From the relation of cause to effect it follows that there must be a 'first mover', and this moves in a circle because circular motion can go on for ever, and 'we always suppose the better to take place in Nature, if it is possible';[3] Aristotle sometimes means by Nature (φύσις) a life distributed over all parts of the world, sometimes an individual life in each living thing, sometimes 'Nature' is identified with God (θεὸς), who is also the totality of all pure forms (i.e. of conceptual being).[4]

Causes

There are four causes (ἀρχαί):

(i) the *material*, the matter (ὕλη) of which anything is made, as bronze of the statue;

(ii) the formal, the form and pattern (μορφή, εἶδος), as the cause of the octave is the ratio 2 : 1;

(iii) the *moving* (τό ὅθεν, ἡ ἀρχή τῆς κίνησεως), the origin of production, as the father of the child;

(iv) the *final* (τό τέλος; τό οὗ ἕνεκα), that for the sake of which anything is done, as health is the cause of walking,[5] putting the cart before the horse, as it were.

The formal cause Aristotle called the *substantial form* (οὐσία ὡς εἶδος), or 'that which makes a thing what it is (ἡ οὐσία καὶ τὸ τι ἦν εἶναι)';[6] the essence (οὐσία) of a thing is what the Schoolmen called its *quiddity*. The quiddity of water is 'aquosity'; water can become warm but it still remains water; its high and low temperatures are 'accidents (σύμβεβηκοτα)' while the substance (οὐσία) remains unchanged.[7] The substantial form is also 'the first entelechy (or activity) of a body (ἐντελέχεια ἡ πρώτη σώματος)' (for the meaning of 'first' see p. 82).

The moving cause was added to explain movement or change (things do not move or change of themselves), and it played a great part in Scholastic philosophy, which divided the final cause into causes *præoptate* and *consequentes*, as when the cure of an invalid or the restoration of health are the two ends considered.[8]

The four causes are reducible to two; the necessary and final, or matter (ὕλη) and form (εἶδος).[9] The form is the moving and purposeful force, the matter the indefinite and (almost) formless entity which can take on actions and properties.[10] The matter offers some resistance to form by 'necessity

[1] I, ii, 1 f., 192*b* f.; iii, 1, 200*b*.
[2] I, iv, 8, 215*a*.
[3] II, i, 2, 269*a*. This is reminiscent of Plato.
[4] II, i, 4, 271*a*; Deussen, (1), II, i, 350; Zeller, (1), II, ii³, 387 f.
[5] I, ii, 3, 195*a*; ii, 8, 199*a*; Kaufmann, 36 f.
[6] IV, ii, 1, 329*a*; X, ii, 1, 412*a*; Lewes, 117; Rolfes, (1); *id.*, (2), 53 f.; Zeller, II, ii³, 207–9, 327.
[7] IV, i, 6, 322*b*.
[8] Peck, in IX (*a*), xxxviii.
[9] Kaufmann, 37; Ueberweg, (1), i, 379; Zeller, (1), II, ii³, 327, 329.
[10] IV, i, 7, 324*b*.

(ἀνάγκη)', as animals are formed when the resistance does not allow the production of human beings, and plants are less perfect than animals; Aristotle calls all imperfect forms 'dwarfs'.[1]

Although there are immaterial existences, all natural substances are bodies or are combined with bodies; the science of nature (ἡ περὶ φύσεως ἐπιστήμη) concerns itself with bodies, and with forms only in so far as they are joined to matter.[2] The material cause (ὕλη) of coming-to-be is 'that which can be and not be', a transient, mutable, substance. The formal and at the same time the final cause is 'the formula expressing the essential nature (ὁ λόγος ὁ τῆς ἑκάστου οὐσίας)' of the things that come-to-be (λόγος is here the same as εἶδος, 'form').[3]

The Elements

An element (στοιχεῖον) is one of those bodies into which the other bodies can be decomposed as contained in them actually or potentially (it is difficult to say which), and which itself is not capable of being divided into others (ἔστω δὴ στοιχεῖον τῶν σωμάτων, εἰς ὃ τἆλλα σώματα διαιρεῖται, ἐνυπάρχον δυνάμει ἢ ἐνεργείᾳ (τοῦτο γὰρ ποτέρως, ἔτι ἀμφισβητήσιμον), αὐτὸ δ' ἐστὶν ἀδιαίρετον εἰς ἕτερα τῷ εἴδει).[4] It is the first inherent (ἐνυπάρχειν) component out of which a thing is constructed, and cannot be analysed into a different form.[5] Aristotle uses the names analysis (διάλυσις) and synthesis (συνθεσις) for separation into and formation from elements (στοιχεία).[6] The elements are 'simple bodies (ἁπλᾶ σώματα)'.[7] Every real thing contains more or less of all four of the so-called elements, fire, air, water, and earth. They all contain earth, since earth predominates in the sublunary region in which alone they are found. All contain water, since compounds have a definite outline and water alone of the elements is readily adaptable in shape, and also earth cannot cohere without moisture. All living things must have both earth and water to nourish them. Since compounds are made out of contraries, they must also contain air and fire, the opposites of earth and water.[8]

Although Aristotle took over the four primary bodies from Empedokles, and (following Plato, p. 56) called them elements (στοιχεῖα), he does not regard them as *ultimate* elements according to his definition. They are the 'so-called elements',[9] 'constituents (ἐνυπαρχοντα)', 'bodies (σώματα)', 'principles (ἀρχάς)', 'simple bodies (ἁπλᾶ σώματα)',[10] 'the four kinds of matter (ὕλη)', 'the four matters (ὗλαι)' in a collective sense,[11] or 'the elements of bodies (τά στοιχεῖα τῶν σωματικῶν)'.[12] They never appear in a pure form.[13] Things

[1] Ueberweg, (2), i, 166; Zeller, (1), II, ii³, 331–9, 427–31.
[2] II, i, 1, 268*a*; Zeller, (1), II, ii³, 384.
[3] IV, ii, 9, 335*b*.
[4] II, iii, 3, 302*a*; Zeller, (1), II, ii³, 443.
[5] XII, Δ, 3, 1014*a*.
[6] II, iii, 6, 304*b*.
[7] IV, ii, 3–4, 330*b*, 331*b*; II, iii, 1, 298*b*.
[8] IV, ii, 8, 334*b*–335*a*; Rolfes, (2), 196.
[9] I, i, 4, 187*b*; iii, 4–5, 203*a*, 205*a*; IV, ii, 1, 329*a* (τά καλούμενα στοιχεῖα); XII, *A*, 4, 985*a* (λεγόμενα σ.); VI, ii, 1, 646*a* (τά καλούμενα ὑπό τινων σ.).
[10] III, i, 2, 339*a*; Gilbert, 185; Zeller, (1), II, ii³, 442–3.
[11] II, iv, 5, 312*a*.
[12] III, i, 1, 338*a*.
[13] IV, i, 318*b*; ii, 3, 8, 330*b*, 334*b*; III, ii, 4, 360*a*; ii, 5, 362*a* (air = smoke + vapour); he quotes Empedokles.

seem to be destroyed when they change into air or wind, and to be created when they form something tangible.[1]

Aristotle begins his accounts of the elements with detailed criticisms of the Ionian philosophers who postulated one or more elements, giving particular attention to Anaxagoras. He says Empedokles' account of the four elements is incomplete, since it does not explain how they pass into one another; the atomic theory of Leukippos and Demokritos, Plato's theory of triangles and ideas of the great and small (pp. 35, 41, 56), and the Pythagorean view of the substantiality of numbers, are all picked to pieces in detail.[2] The real reason why the elements change into one another is not (as earlier philosophers said) pure chance, nor love and strife, nor sorting out, but their organisation or essential nature (ἡ ἑκάστου φύσις αὕτη).[3]

All material bodies are cognisable by touch, and all the properties (ἀρχαί) so felt, except weight and levity (which cannot be included, since they are neither active nor passive) are in the end reducible to four, all of equal rank,[4] viz. heat, cold, dryness, and moistness. These have the requisite active and passive qualities, without which things could not act upon one another and so undergo changes. Heat and cold are active (ποιητικά), dryness and moistness passive (παθητικά).[5] The moist (liquid) has no determinate form in itself but readily receives that of the vessel it is in, whilst the dry (solid) has a determined form within its proper limits, which is altered only with difficulty. Secondary properties (*qualitates secundae*), as fine, coarse, brittle, hard, soft, viscous, etc., are all derivable from the dry and the moist. Hardness is the result of dryness, softness of moisture; density of cold, making the particles approach, dilation of heat, which separates them.[6] Pythagoras had given pairs of opposites (see p. 12), which did not include Aristotle's.[7]

The primary properties are attached to a material substratum inseparable from them (τῶν σωμάτων τῶν αἰσθητῶν, ἀλλὰ ταύτην οὐ χωριστὴν), or a potentially perceptible body[8] (δυνάμει σῶμα αἰσθητὸν). The four elementary qualities (στοιχεῖα, here used for ἀρχαί) form six possible pairs, but since opposites cannot be coupled together, as heat with cold, or moistness with dryness, there remain only four pairs:

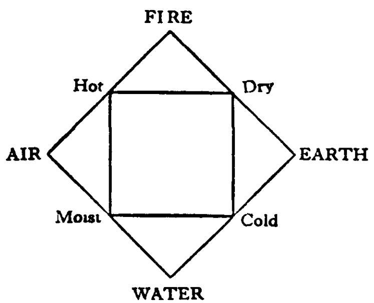
hot + dry = *fire*
hot + moist = *air*, which is a kind of steam (οἷον ἀτμὶς γὰρ ὁ ἀήρ)
cold + dry = *earth*
cold + moist = *water*.

'The division of the opposites (ἐναντια) among the primary bodies is thus easily understood, and the numbers of the one and of the other are in perfect

[1] IV, i, 3, 318*b*.
[2] I, i, 4–6, 187*a*–189*b*; II, iii, 1–8, 299*a*–307*b*; IV, i, 2, 315*b*; Brandis, (1), II, ii, 600 f., 612, 626, 967; Diels, (2), 24; Rolfes, (1), 50 f.; A. E. Taylor, (1), 401, 403, 408; Zeller, (1), II, ii[3], 441.
[3] IV, i, 2, 317*a*; ii, 6, 333*a*–334*a*.
[4] I, iv, 5, 212*b*; III, i, 3, 339*b*; IV, i, 6, 322*b*–323*a*; ii, 2, 329*b*.
[5] III, iv, 1, 378*b*; IV, i, 6–7, 322*b*–324*a*; ii, 2, 329*b*–330*a*; Zeller, (1), II, ii[3], 455.
[6] I, i, 5, 188*b*; IV, ii, 2, 329*b*–330*a*.
[7] XII, *A*, 5, 986*a*; Whewell, (1), i, 31.
[8] IV, ii, 1, 329*a*.

accord.' Each element contains one active and one passive quality. Actual fire and air, and each of the bodies mentioned, are not simple but blended (μικτόν). The simple bodies are similar to but not identical in nature with them. The simple body corresponding with fire is 'such-as-fire (πυροειδές)', not 'fire'; that corresponding with air is 'such-as-air (ἀεροειδές)', not air; and so on. Fire is an excess of heat, ice an excess of cold, for freezing and boiling are excesses of heat and cold, respectively. If ice is a freezing of moist and cold, fire will be a boiling of dry and hot.[1] Moist and dry are primary attributes of the elements, and through them come the non-elemental moistness and dryness, which are reduced to the primary attributes and are caused by them.[2]

The qualities must exist in matter in different degrees, since if opposite qualities just cancelled each other a product from given elements would be simply the formless primary matter (τί λείπεται πλὴν ὕλην εἶναι τὸ ἐξ ἐκείνων).[3] In one place[4] earth is said to be more dry than cold, water more cold than moist, and air more moist than warm; in others[5] water is more moist than cold, and perhaps the latter is the more characteristic doctrine; in any case each element has one of the pair of opposites predominant. The combination of opposites is shown in the figure.



Medieval works on alchemy and medicine contain very elaborate diagrams,[6] associated in the medical works with astrology and the four 'humours' (see p. 29): fire-blood (red), air-bile (yellow), water-phlegm (white), earth-black bile. The so-called 'cross of the elements', taken in the order fire, air, earth, and water, had a central point typifying the unity of the four elements, or the quintessence (fifth element), which was the same as the Pythagorean ὁλκάς, the Hindu *ākāsá*, the *avir* of the *Qabbalaah*, and the Taoist *ch'i*.[7]

A body is not heavy or light because it is compact or expanded (as the Atomists taught) but 'by nature'.[8] There is a definite 'up and down' in the universe, 'up' being away from, and 'down' towards, the centre (i.e. the earth).[9] The reason is not to be asked: 'motion of a body to its own place is motion to its own form'; fire rises and earth sinks 'by nature (κατὰ φύσιν)'. Fire always rises and earth always sinks, but the intermediate elements have a double potentiality, air tending to rise in water or earth, but sink below fire; water tending to rise in earth, but sink below air or fire. Aristotle thus distinguished between absolutely and relatively heavy and light.[10]

[1] IV, ii, 3, 330*a*–*b*; XII, *A* (1), 8, 988*b*–989*a*.
[2] IV, ii, 1–2, 329*b*–330*a*; R. Bacon, *Opus Majus*, tr. Burke, 1928, ii, 423.
[3] IV, ii, 7, 334*b*; I, i, 9, 192*a*; Rolfes, (2), 192 f.
[4] IV, ii, 3, 331*a*. [5] IV, ii, 8, 335*a*; III, iv, 4, 382*a*.
[6] T. L. Davis, *Technology Review*, 1929, xxxi, no. 8; *Pretiosa Margarita Novella*, Venice, 1546, **viii *r*; Rodwell, *The Birth of Chemistry*, 1874, 23, Fig. 1; Seyfert, *A. Med.*, 1928, xx, 385, Fig. 6; Singer, *A Short History of Medicine*, 1928, 34, Fig. 13.
[7] Evola, 50 f.
[8] II, i, 2, 269*b*; iii, 5, 304*b*; iv, 4–5, 311*b*–312*b*; Rolfes, (2), 174. [9] II, i, 2, 268*b*.
[10] II, i, 2, 268*b*–269*a*; iv, 3, 4, 310*a*–311*b*; Brandis, II, ii, 968, 972, 1024; Ross, (2), 99; Zeller, (1), II, ii^{3}. 414, 440.

In the universe the elements are arranged in strata according to their densities. The celestial or heavenly sphere above the Moon contains the fifth element (ether), below which is the terrestrial region comprised of fire, air, water, and earth (in the centre) in this order from above. The fire and air regions overlap; there is more fire in the upper, and more air in the lower, parts of the atmosphere.[1] Air and water sink when the body below is removed (Aristotle recognised that they could also rise, but does not explain why they do not). A body containing more air can be heavier in air but lighter in water than one containing less air, as a hundredweight of wood as compared with a pound of lead, and even air has weight in its place, for a bladder is heavier when inflated.[2] Aristotle discusses previous views on the shape of the earth[3] and concludes that it is spherical and at rest.[4]

There is only one heaven and nothing, not even a vacuum, outside it; it is ungenerated and indestructible, as is the whole cosmos or universe. The 'natural places' of the elements show that there is only one universe with the earth in the centre, since if there were others the earths in them would all go to that centre. The universe is complete (τό πᾶν) on all sides and so is spherical, but not necessarily infinite. The central earth is at rest but the spherical heaven is rotating about it, being moved by the 'unmoved mover' (see p. 83) in contact with its exterior limit.[5] A quantity is infinite if it is such that we can always take a part outside what has already been taken; what has nothing outside it is complete (τέλειον) and whole (ὅλον).[6]

Outside and above the sphere of fire (τό πῦρ τῷ ἄνω στοιχείῳ) is the region of ether (αἰθήρ), a name which (following Plato)[7] Aristotle derives from ἀεὶ θέω, I run, since 'it runs always for an eternity of time'. Anaxagoras 'scandalously misuses this name, taking *aither* as equivalent to fire'.[8] Aristotle once[9] gives the order of the regions as: earth, water, air, ether, and heaven, and so seems to identify ether with fire. Ether is a divine (a play on θεῖος) substance of which the heavens and stars are composed (τό τῶν ἄστρων στοιχεῖον), lacking opposites, and not transmutable into the other elements and not undergoing any changes.[10] There has been much discussion as to whether Aristotle regarded ether as one of the elements, since it lacks 'opposites'. In the apocryphal *De Mundo* it is the substance of the heavens, an element differing from the four others because it is divine.[11] It is substantial,[12] 'the first

[1] III, i, 3–4, 339*b*–341*b*, and note in III (*e*), 24; Ross, (1), 97.
[2] II, iv, 4, 311*a*–312*a*; and note by Stocks, in C, ii; Zeller, (1), II, ii³, 440, 444–8.
[3] II, ii, 13, 293*b*–296*a*.
[4] II, ii, 13, 14, 294*b*–298*a*; Prantl, (2) (*b*), ii, 319, says Aristotle's estimate of the circumference as 400,000 stadia (9987 geographical miles, modern 5400) is the oldest known.
[5] II, i, 7–12, 274*a*–283*b*; ii, 2–4, 285*a*–287*b*; Rolfes, (2), 151–7; Zeller, (1), II, ii³, 358, 433, 446.
[6] I, iii, 6, 207*a*.
[7] *Kratylos*, 410B.
[8] II, i, 3, 270*b*: III, i, 3, 339*b*, 341*a* (deriving αἰθήρ from αἴθω, I burn); III, iii, 3, 302*b*: 'to him fire and *aither* are the same thing'.
[9] I, iv, 5,212*b*.
[10] II, i, 3, 270*a*–*b*; ii, 8, 290a; iii, 1, 298*b*.
[11] ϵ′, ii, 392*a*; Baeumker, 245 ('keine substantiale Materie', ref. to XII, Λ (xii), 2, 1069*b*: 'things eternal and not generable, but subject to motion, have matter, though it is not the matter of generation and only of motion'; Lewes, 140–1; Zeller, (1), II, ii³, 438.
[12] II, i, 2–3, 269*b*–270*b*; ii, 7, 289*a*; III, i, 3, 340*a*; X, ii, 7, 418*b* ('something identical with fire'); Baeumker, 245; Deussen, (1), II, i, 356; Rolfes, (2), 170; Zeller, (1), II, ii³, 435 f., 446, 50–1, 456.

element (πρώτον στοιχεῖον)' and a 'body (σῶμα)'.[1] It was later called the 'fifth body (τό πεμπτὸν σῶμα)';[2] this name, and 'fifth essence (πεμπτη οὐσία, *quinta essentia*)', are found in fragments attributed to Philolaos (p. 13).[3] Aristotle seems to have regarded the ether as divine but in some sense a body, since 'all perceptible substances have matter', and the stars are visible.[4] Simplikios quotes a treatise 'against the quintessence (πρὸς τήν πέμπτην οὐσίαν)' by Xenarchos of Seleucia (*c.* 50 B.C.), which criticised some of Aristotle's physics.[5] The idea that the heavenly bodies were 'perfect' and composed of ether persisted until the observation of spots on the sun in 1611.[6] Aristotle[7] still thought that comets are transitory meteors, whilst the Babylonians as reported by Seneca[8] and Pliny[9] regarded them as stars or planets like the sun and moon.

Heat is generated by friction, so that wood, stone, and iron can become red-hot; this must happen also in motion in the air, which is next to the region of fire, so that lead shots fired through the air can be melted, the air being turned into fire by the agitation produced by their movement. The air under the moving sphere on which the heavenly bodies are turned is heated by its motion, particularly in that part where the sun is attached to it. (The heavenly bodies, being composed of ether, which has no opposites, cannot themselves be ignited).[10] Motion as such cools a heated body; 'every hot body is cooled by the motions of bodies external to itself', and a fan cools by its motion and not by propelling cooler air.[11]

Since fire, not air, is in contact with the stars it is hard to see how air is heated, but the ether varies in purity, becoming mixed with fire and air as it comes nearer the earth, and the substance of fire is like inflammable material which needs only a little motion to make it inflame.[12]

The sun is almost the sole source of life and warmth on the earth; its annual movement in the ecliptic or zodiacal circle is the efficient cause of coming-to-be and passing away, and their ceaseless alternation, including animal life.[13]

Antiperistasis

It is fundamental with Aristotle that opposites *as such* do not act upon each other. A cold thing can be acted upon by a warm thing, but not cold directly by heat; they require a substrate which is not an opposite to either, viz. matter.[14] Neither can one opposite pass directly into the other, but only as they are determined by the substrate.[15] Aristotle introduced the idea of *antiperistasis*

[1] II, iii, 1, 298*b*; III, i, 1, 3, 338*b*–339*b*.
[2] Hippolytos, i, 20; *id.*, (1), 38; Reitzenstein, (1), 65 (Stoic); A. E. Taylor, (i), 88 f.
[3] LSJ, 1359. [4] Joachim, in IV (*c*), p. xxxiii. [5] Ueberweg, (1), i, 560.
[6] Humboldt, *Cosmos*, 1849, ii, 706. [7] III, i, 7, 944*a*. [8] *Nat. Quaest.*, vii, 17.
[9] ii, 23. [10] II, ii, 7, 289*a*; III, i, 3, 341*a*; Ideler, III (*c*), i, 359.
[11] VI, iii, 4, 6, 667*a*, 669*a*; XI, (vii), vi, 470*a*; XI, (viii), ix, 475*a*; Ogle, XI (*k*), 115, says this, and the idea that right is superior to left and upper to lower, are Aristotle's 'most mischievous errors'.
[12] III, i, 3–4, 340–41*b*. Alexander of Aphrodisias and Simplikios said that 'air' must in some sense include fire or the fuel of fire (ὑπέκκαυμα) occupying the outer place; Stocks, II (*e*), 289*a*.
[13] I, viii, 7–9, 260*b*–266*a*; III, i, 9, 346*b*; IV, ii, 10–11, 336*a*–338*b*; XI, iv, 10, 777*b*.
[14] XII, xii, 10, 1075*a*: ἀπαθῆ γὰρ τὰ ἐναντια ὑπ' ἀλλήλων; Baeumker, 221.
[15] I, i, 5, 188*a*; IV, i, 6, 322*b*; ii, l, 329*a*; XII, xiv, 1, 1087*a*.

(ἀντιπερίστασις) for a 'reaction' of qualities, which has some relation to Le Chatelier's 'law of reaction'.[1] Another aspect is the 'abhorrence of a vacuum (*horror vacui*)'.[2] The classical example in Aristotle is that heat repels cold, which explains why showers of hail fall in late summer. Water which has been boiled freezes sooner than unboiled, since on heating the cold is concentrated in the water, heat and cold having a mutual reaction.[3] Underground places (cellars) are cold in hot weather and warm in frosty weather. Cold is more concentrated within by heat without, and freezes the water which it has produced, so forming hail.

Aristotle sometimes uses *antiperistasis* to mean 'to oppose or compress by the surrounding', sometimes 'to be replaced by another substance'.[4] Simplikios defined it as the transmission of a push through a number of bodies so that the second took the place of the first, and so on until 'the last body arrives at the place of that which gave the first push'.[5] The idea is often used in the *Problems*.[6] It is a favourite doctrine of Theophrastos.[7] Lucretius[8] gave an atomic explanation: atoms of heat pass from the water to and from the porous earth round a well as the earth is expanded or contracted by external heat and cold. The idea was taken over by the Stoics, Francis Bacon used it, and Boyle wrote a special work to refute it (see Vol. II, p. 509).[9]

Coming-to-Be and Passing-Away

Coming-to-be (ἡ γένησις, genesis; *ortus*) and passing-away (ἡ φθορά, phthora; *corruptio*, *interitus*) involve alteration of substance, as when water changes into air; simple 'change (μεταβολή, metabolē; *mutatio*)', as when a statue is formed from bronze, does not involve change of substance. Coming-to-be must also be distinguished from 'alteration (ἀλλοίωσις)'.[10] The theories of Empedokles, Anaxagoras, Leukippos, and Demokritos, Aristotle said, are unsatisfactory.[11] They failed to appreciate that there are really *three* aspects of becoming: (i) by contact (ἁφή), (ii) by action (ποίησις), and (iii) by 'mixtion (μίξις)'.[12] Purely mechanical changes of an unchanging substance, as postulated by the atomists, do not explain even physical changes, many of which require a change of substance and are qualitative. No one (he includes Plato by name) had attended to these matters with understanding, except Demokritos,[13] and the atomic theory is better than Plato's theory of triangles.

The problem is perplexing and difficult, and must be approached from different sides; 'in one sense it is and in another sense it is not true' (a favourite expression of Aristotle's), but a solution can be reached. We must first be clear that one substance A is not another B (water is not air), yet in another sense it

[1] Van Deventer, *Z. phys. Chem.*, 1927, cxxx, 33.
[2] Zabarella, De Reactione, in *De Rebvs Natvralibvs*, Frankfurt, 1607, 426.
[3] III, i, 12, 384*a*–*b*; δ', xxiv, 13, 937*a*; see Black, Vol. III, p. 132.
[4] III, i, 12, 348*b*–349*a*; Lee, III (*e*), 82. [5] Ross, XI (*c*) 264.
[6] δ', ii, 16, 867*b*; iii, 26, 874*b*–875*a*; xiv, 3, 909*a*; xxiv, 8, 936*b*; xxiv, 13, 937*a*, etc.; γ', 50, 834*a*; Forster, C, vii, 867*b*.
[7] *De caus. plant.*, I, xii, 3; II, ix, 8; VI, viii, 8; *De igne*, xiii, 74; *De sudore*, 23; Seneca, *Quaest. Nat.*, ii, 7: Graeci ἀντιπερίστασιν appellant, quae in aëre quoque sicut in aqua fit.
[8] N, i, vi, 848–78.
[9] K. Meyer-Bjerrum, Zur Geschichte der Antiperistasis *Ann. Naturphil.*, 1904, iii, 413–41.
[10] II, iii, 1, 298*b*; iv, i, 1, 4, 314*a*, 319*b*.
[11] IV, i, 1–2, 314*a*–317*a*; Zeller, (1), II, ii³, 393, 406.
[12] IV, i, 1, 2, 314*a*–315*b*; i, 6, 322*b*; Rolfes, (2), 185. [13] IV, i, 2, 315*b*.

is, since B can turn into A and A into B. A is potentially (δυνάμει) but not actually (ἐντελεχείᾳ) B; when B comes-to-be from A, what was potentially B is now actually B. Secondly, the passing-away of one substance involves the coming-to-be of another, and *vice versa*; coming-to-be and passing-away are two aspects of a single transformation. A change in which a substance produced has a higher reality or more positive character than the other, as fire from earth, is an 'unqualified (ἁπλή)' coming-to-be and only a 'qualified (οὐχ ἁπλή)' passing-away, since heat is a form of which cold is the privation (στέρησις). Thus, (dry + cold) passing into (dry + hot) is an 'unqualified' coming-to-be, the less positive cold becoming the more positive hot.[1]

Experience shows that the four simple bodies (ἁπλῶν σωμάτων) can be changed into one another.[2] Some pairs of simple bodies have *two* different pairs of opposites, as water (cold + moist) and fire (hot + dry), whilst others have only *one* pair, as air (hot + moist) and water (cold + moist). When the change (μεταβολή) from contrary to contrary is in quantity it is growth and diminution (αὔξη καὶ φθίσις), when it is in place it is motion (φορά), when it is in property or quality (κατὰ πάθος καὶ τὸ ποίον) it is alteration (ἀλλοίωσις); but when nothing persists of which the resultant is a property or accident (συμβεβηκὸς) in any sense, it is coming-to-be (γένεσις) or passing-away (φθορά).[3]

The changes of the four elements into one another are all possible but they may take place more or less quickly or more or less easily (δὲ τῷ θᾶττον καὶ βραδύτερον καὶ τῷ ῥᾷον καὶ χαλεπώτερον); elements having one quality in common (air and water) change quickly, whilst elements with no quality in common (water and fire) change slowly.[4] Air becomes fire by change of one quality (moist to dry); when the dry is dominated by the moist it produces air, and from air water can be formed when the hot is dominated by the cold. In the same way earth (cold and dry) may become water (cold and moist), and earth (cold and dry) may become fire (hot and dry). These changes proceed, as it were, in a circle (Fig. 3), and this mode is the simplest of all, since elements which follow one another have always points of union, and all the elements thus form one whole. The view that fire becomes air by 'the way down (κάτω ὁδὸς)' and air becomes fire by 'the way up (ἄνω ὁδὸς)', comes from Herakleitos and Plato.[5] Each of the transformations:

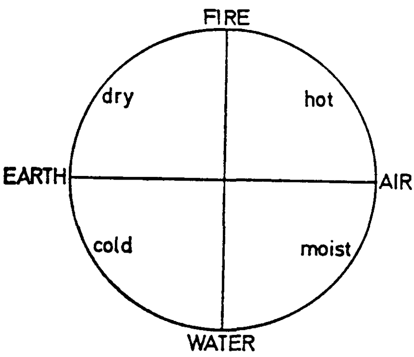


FIG. 3.

[1] IV, i, 3, 317*b*–318*a*.
[2] II, iii, 6, 305*a*; IV, ii, 4, 331*a*; Baeumker, 237; Brandis, (1), II, ii, 978, 1036; Deussen, (1), II, i, 356; Gilbert, 179, 188, 190, 290, 386, 462; Zeller, (1), II, ii³, 445.
[3] IV, i, 4, 319*b*–320*a*; ii, 1, 329*a*; II, iii, 7, 305*b*; Rolfes, (1), 49.
[4] IV, ii, 4, 331*a*.
[5] II, iv, 3, 310*b*; IV, ii, 4, 331*b*; ii, 11, 338*a*; Gilbert, 188; for the superiority of motion up, right, and front, over motion down, left, and back, see II, ii, 2, 5, 284*a*, 288*a*, and note by Stocks, II (*c*); Zeller, (1), II, ii³, 445.

Fire⇄Air⇄Water⇄Earth

is rapid and easy, but the transformations:

Fire⇄Water and Air⇄Earth,

although possible, are slow and difficult, since *two* qualities (ποιότητες) have to change. In some cases a thing cannot change into another unless it is resolved into its elements and is reconstituted from these.[1] When the moist of air and the cold of earth have passed away there will remain the hot of air and the dry of earth, qualities constituting fire. This is confirmed by observation, for flame is *par excellence* fire; but flame is burning smoke and smoke consists of earth and air: μάλιστα μὲν γὰρ πῦρ ἡ φλόξ, αὕτη δ' ἐστὶ καπνὸς καιόμενος, ὁ δὲ καπνὸς ἐξ ἀέρος καὶ γῆς.[2]

Aristotle's theory of chemical change seems to have involved the assumption[3] that a body A, composed of the four elements in the proportions $A_1 = \alpha_1 + \beta_1 + \gamma_1 + \delta_1$, changes most easily into another body $A_2 = \alpha_2 + \beta_2 + \gamma_2 + \delta_2$ as α_1 is nearer to α_2, etc., or has been altered to near equality *before* the change occurs. Also, things are generally formed from others of similar composition.[4]

Mechanical (external) mixture (σύνθεσις, synthesis; *compositio*), which is a mere juxtaposition of particles (even the finest) is quite different from chemical (internal) mixture (μῖξις, mixis; or κρᾶσις, krasis, *mistio*) in which the substances (χωριστά), although not destroyed, undergo a medium change and produce a new substance (μιχθέν, michthen), of uniform particles (ὁμοι ομερές) in which the substances mixed do not exist actually but can be recovered again with their original properties.[5] Immaterial things, or forms, or properties cannot undergo mistion (μῖξις). This theory is, from our point of view, the most important, and the most difficult to understand.

The elements are constantly undergoing transformations one into the others in a cycle (κύκλῳ); they are in a constant state of becoming and passing away. Contraries suffer action (in a way explained in detail),[6] so that hot and cold, unless they are in equilibrium (ἰσάζῃ), are transformed into one another.[7] The growth of living beings differs from generation and destruction.[8] It occurs by a form immersed in matter, a kind of immaterial power (οὖσα δυνάμει ἄϋλος)', and nutriment is potentially flesh; as fire lays hold of a combustible (ὥσπερ τὸ πῦρ ἁψάμενον τοῦ καυστοῦ) and converts it into fire, so the active principle (ἐντελέχεια) of growth lays hold of an acceding food and converts what is potentially flesh into actual flesh.

The components of a mixt[9] were first separate things and they can be

[1] XII, *H* (viii), 5, 1044*b*–1045*a*. [2] IV, ii, 4, 331*b*.

[3] IV, 320*a*, 324*a*, 328*a*, 334*b*; Stephanides, *Rev. Scient.*, 1924, lxii, 626.

[4] III, iv, 1, 378*a*–*b*.

[5] III, iv, 1, 378*b*–379*a*; IV, i, 10, 327*a*–*b*; Albertus Magnus, *De gen. et corr.*, i, 6 (de mixtione), *Opera*, ed. Borgnet, iv, 408–16; Gilbert, 265; Hicks, X (*b*), 264; Joachim, (1), 72 f.; *id.*, IV (*c*); Lasswitz, (1), i, 124 f.; Rolfes, (1), 47 f.; *id.*, (2), 178; J. Zabarella, *De Rebvs Natvralibvs*, Frankfurt, 1607, 451 f. (*De mistione*); Zeller, (1), II, ii[3], 420.

[6] IV, i, 7, 324*a*.

[7] II, iv, 3, 310*b*–311*a*; III, ii, 3, 357*b*; IV, ii, 7, 334*b*; Baeumker, 260; Gilbert, 259; Zeller, (1), II, ii[3], 446.

[8] IV, i, 5, 320*a*–322*a*. [9] IV, i, 10, 328*a*–*b*.

obtained again from the mixt. They exist in it neither actually nor potentially, neither do they disappear, since their 'power' is retained. They are not merely so finely divided that they are no longer perceptible as such to the senses, since this would be a mechanical mixture (σύνθεσις) rather than a combination (μίξις), but the mixt is a uniform one (ὁμοιομερὲς εἶναι), just as the parts of a mass of water are water. The first, mechanical, mixture, although not perceptibly mixed, would appear so to the eye of the Lynx, the particles lying side by side. The parts of a true mixt act upon one another (τῶν ὄντων τὰ μὲν ποιητικά, τὰ δ' ὑπὸ τούτων παθητικά). When they hold themselves in equilibrium with their forces, then each changes from its own nature into that of the one in excess (as a drop of wine in a large quantity of water is converted into water), yet it does not produce the other but a mean or common state of the two (οὐ γίνεται δὲ θάτεροι, ἀλλὰ μεταξὺ καὶ κοινόν). Liquid bodies, easily divided, are most easily mixed.

Some things have no fixed state and fluctuate between two kinds of being; one is the receiver and the other the form (ὡς θάτερον μὲν δεκτικον θάτερον δ' εἶδος). This happens when tin is mixed with copper in making bronze, 'for the tin almost vanishes, behaving as if it were an immaterial property of the bronze, leaving no trace except the colour it has imparted to the copper (ὁ γὰρ καττίτερος ὡς πάθος τι ὢν ἄνευ ὕλης τοῦ χαλκοῦ σχεδὸν ἀφανίζεται, καὶ μιχθεὶς ἄπεισι χρωματίσας μόνον).'[1]

A spurious work[2] suggests that the tin disappears owing to division into extremely small parts, as the parts of a dyed skin between the pores (into which the colour enters) are too small to be perceptible as undyed patches. 'By itself the space between the pores is not visible because of its smallness, just as tin is not noticed when it is mixed with copper, nor any such other similar thing: διὰ σμικρότητα, καθάπερ οὐδὲ καττίτερος τῷ χαλκῷ κραθεὶς, οὐδὲ τῶν ἄλλων οὐθὲν τῶν τοιούτων (aut ulla alia hujusmodi res).'

The opposite qualities of the different elements in the mixt do not completely destroy one another but by their reciprocal action they reduce themselves to a certain average, and the elements are present not actually but potentially (τότε οὔθ' ἡ ὕλη ἔσται οὔτε ἐκείνων τῶν ἐναντίων ἑκάτερον ἐντελεχείᾳ ἁπλῶς, ἀλλὰ μεταξύ).[3] The elements are not destroyed, since they can be separated again, and they are thus potentially but not actually present (οὔτε φθείρονται, οὔτε θάτερον οὔτ' ἄμφω· σώζεται γὰρ ἡ δύναμις αὐτῶν).[4]

Wine is not the 'matter' of vinegar but the normal product of the same matter of which vinegar is the abnormal product. There is no *direct* transition from the normal to the abnormal product or *vice versa*; the given product must first be reduced to its constituent matter (water): 'all the things which change thus into one another must be reduced to their [primary] matter . . .

[1] IV, i, 10, 328*b*. 13; B, ii, 453 (nam stannum quasi affectio quaedam sine materia aeris, paene evanescit, misturae toti colore solum indito); Benn, i, 314, 366; Kopp, (2), i, 26; Lippmann, (2), i, 119; Prantl, (1); *id.*, (2), ii, 427, 502; Salmasius, (2), 228; Strunz, (1), 68 (alchemical significance); Wiegleb, (1), 1792, 88–9 (emphasising this before Prantl).
[2] *β'*, iv, 794*b*; see also Plutarch, *De fraterno amore*, p. 491; *Opera*, ed. Dübner, Paris, 1841, iii, 594: ὡς γὰρ ὁ κασσίτερος ῥαγέντα τὸν χαλκὸν συναρμόττει καὶ συγκεράννυσι, τῷ ψαύειν ἑκατέρου πέρατος, ῥικείως ὁμοιοπαθῆς γενόμενας; and J. G. Schneider, (2), 1796, IV, ii, 31.
[3] IV, ii, 7, 334*b*.
[4] IV, i, 10, 327*b*; Baeumker, 244.

vinegar is first reduced to a formless fluid and only then becomes wine (ὅσα δὴ οὕτω μεταβάλλει εἰς ἄλληλα, εἰς τὴν ὕλην ἐπανελθεῖν).'[1]

Hipponax and Kallimachos (3 cent. B.C.) explained the name 'dead wine (νεκρός ἀλίβας)' for vinegar in this way.[2] Empedokles had explained the formation of water from wine by 'putrefaction (σῆψις)'; Epikouros thought wine became 'cold' vinegar by loss of heat atoms.[3]

There is a 'definite ratio of composition (λόγος τῆς μίξεως)' of the elements or components (ὁμοιομερῆ), which in a definite thing are not combined haphazard but in a fixed ratio (οὐ γὰρ ὁπωσοῦν ἔχοντα τὰ στοιχεῖα τούτων ἕκαστον, ἀλλὰ λόγῳ τινὶ καὶ συνθέσει).[4]

Homœomerous bodies (ὁμοιομερῆ σώματα), viz. metals, stones, and the parts of vegetables (wood, bark, etc.) and of animals (bone, flesh, sinews), may be classified according to their material constituents, the elements (στοιχεία), but their essential reality is in the formal definition (κατ' οὐσίαν τῷ λόγῳ). 'Matter is simply matter, essential reality is simply formal definition, and things intermediate are related to these two extremes according to their proximity to each, for each has some final cause and is not just water or fire, nor just flesh and intestines.'[5]

Aristotle rejects an atomic view of mixtion; the result is not a mixture of different kinds of small particles, like a grey powder formed of black and white powders, but in the change of a black thing into a white, each smallest particle changes suddenly from black to white without passing through the stage of grey.[6] A σύνθεσις is a mechanical mixture or *parathesis* (ἡ παραθεσις), in which the components suffer no internal change; κρᾶσις always and μῖξις often, denote a chemical change, the component parts being modified or even losing their identity.[7] But the use is not always consistent.[8]

'In a word mixtion is the union with alteration of the things combined (ἡ δὲ μίξις τῶν μικτῶν ἀλλοιωθέντων ἕνωσις).' There are three conditions for mixtion: (i) the things forming the mixt must exert reciprocal action on one another, as when they are of the same substance; (ii) their powers (material qualities) must be in a certain equilibrium, without being completely destroyed or surviving absolutely unaltered; (iii) there must be a state of division and contact (hence liquids easily react).[9] No one constituent is absolutely 'dominant', each 'suffers action' from the other, they meet each other half-way, and the result is a compromise. Every single part is fused with every other part, just as the whole is fused together (ἅπαν ἅπαντι μέρος μέμικται ὁμοίως καὶ τὸ

[1] XII, *H* (viii), 5, 1044*b*–1045*a*.

[2] Immisch, *A. Rel.*, 1911, xiv, 449.

[3] Gilbert, 213, 342.

[4] IV, i, 5, 322*a*; i, 10, 328*a*; VI, i, 1, 642*a*; X, i, 4, 408*a*; i, 5, 410*a* (q. Empedokles); Hicks, X (*b*), 264, 290; Joachim, IV (*c*), 64, 70, 136, 183, 188, 231, 235; Albutt, 108 (a law of definite proportions).

[5] III, iv, 11–12, 389*a*–390*b*.

[6] IV, i, 10, 328*a*; Ross, XII (*c*), ii, 236.

[7] IV, i, 10, 328*a*.

[8] XII, *H*, 1, 1042*b* (κρᾶσις an instance of σύνθεσις); *N*, 5, 1092*b* (μῖξει distinguished from συνθέσει); *M*, 9, 1085*b* (μίξις ἢ θέσις ἢ κρᾶσις, three mutually exclusive modes of forming compounds); Hicks, X (*b*), 271. Alexander of Aphrodisias also wrote a treatise on mixtion (περὶ μίξεως, or περὶ κράσεως), printed at the end of *Joannes Grammaticvs in libros de generatione, et interitv. Alexander Aphrodisiensis in Meteorologica. Item de Mixtione*, la 8°, Venice (Aldus), 1527; and in Ideler, III (*c*), ii, 587–624; it is mainly a criticism of the Stoics.

[9] IV, i, 10, 328*b*. 25; Joachim, IV (*c*), 186; Saint-Hilaire, tr. IV, D, 1866, i, 10, § 10.

ὅλον);[1] the result is what the Stoics later called a 'complete mixture (ἡ δι' ὅλον κρᾶσις)'[2] and Aristotle calls it τῷ πάντῃ μεμῖχθαι.[3] Materials whose shape is readily adaptable, i.e. easily divided into small particles, tend to 'combine', and liquids are the most combinable of all bodies, except when they are 'viscous', when the only effect is an increase in volume.[4]

The Two Exhalations

The earth when heated by the sun gives off two kinds of exhalation (ἀναθυμίασιν), not one as some think. (i) A more vaporous, cool and moist, and called vapour (ἀτμίς), formed from water in and on the earth. (ii) A windy (πνευματώδης) or smoky (καπνώδης), hot and dry, formed from earth itself; it rises above the more watery exhalation and occupies the zone of fire; it has no special name but is a 'kind of smoke (αὐτὴν οἷον καπνόν)'. The two exhalations form the atmospheric air.[5] The two exhalations, one vaporous and one smoky (δύο μὲν γὰρ αἱ ἀναθυμιάσεις, ἡ μὲν ἀτμιδώδης ἡ δὲ καπνώδης), produce two corresponding kinds of bodies in the earth. The vaporous produces metals (μεταλλευτά, including ores) such as iron, gold, and copper; the smoky produces minerals (ὀρυκτά, *fossilia*).[6] The minerals include insoluble (ἄτηκτα) such as realgar (σανδάρακη), ochre (ὤχρα), ruddle (μίλτος), and sulphur (θεῖον).[7] Most minerals are coloured dust (κονία κεχρωματισμένη),[8] or stone (λίθος) formed of a similar composition (ἐκ τοιαύτης γεγονὼς συστάσεως), such as cinnabar (κιννάβαρι). Metals, all fusible or ductile (ἢ χυτὰ ἢ ἐλατά), such as iron, gold, and copper, are produced by the enclosure of the vaporous exhalation, particularly within stones, whose dryness presses it together and solidifies it. They are in one sense (potentially) water, in another (actually) not. It was possible for their material to turn into water, but it can no longer do so; they are formed by solidification of the vaporous exhalation before it turns into water; all except gold are affected by fire and contain earth, for they contain dry exhalation.[9]

Effects of Heat and Cold

Heat and cold are active qualities, and changes in matter are produced by their operation.[10] The effect of heat on substances is called in general concoction (πέψις, *pepsis*), of which there are three kinds: ripening (πέπανσις, *pepansis*), boiling (ἕψησις, *hepsēsis*), and roasting (ὄπτησις, *optēsis*).[11] Hepsēsis is

[1] Aristotle, *De Melisso*, 977*a*; Hett, XI (*b*), 481.
[2] Baeumker, 244; Zeller, (1), II, ii³, 421.
[3] XI, (i), iii, 440*a–b*.
[4] IV, i, 10, 328*b*: εὐόριστον γὰρ μάλιστα τὸ ὑγρὸν τῶν διαιρετῶν, ἐὰν μὴ γλίσχρον ᾖ. Stephanides, *Rev. Scient.*, 1924, lxii, 626–7, thinks the word 'affinity' comes from *ad fines*, 'the limits', συνορέω, 'to be conterminous', and συναφής (συναφὴ), 'connected', and hence related to Aristotle's idea of mixtion; he refers to ψ-Demokritos: Berthelot, (2), ii, 427. 5, 16, τὰ γένη συνάψει, 'combine the species'.
[5] III, i, 3, 4, 340*b*, 341*b*; ii, 4, 359*b*; iv, 8, 384*b*; V, viii, 24, 604*b*; Ross, (1), 109; Lee, III (*e*), 20, 312, who alters (on the basis of two good MSS.) 'moist and hot' of vapour (ἀτμίς) to moist and cold', the exhalation (ἀναθυμιάσεως) being 'dry and hot'.
[6] E. D. Eicholz, *Class Quart.*, 1949, xliii, 141; Ideler, III (*c*), ii, 32.
[7] Ideler has *non liquabilia* and Lee, III (*e*), 287, 'infusible'; but sulphur is fusible and realgar sublimes.
[8] Ideler, *pulvis colore tinctus*; Eicholz, 'dust'.
[9] III, iii, 6, 378*a–b*.
[10] III, iv, 1, 378*b*–379*b*: effects in detail.
[11] III, iv, 2, 379*b*–380*a*.

more generally cooking (*coquere*), used in a technical sense in chemical authors, who distinguish it from optēsis.[1] In the ripening of fruits it is fermentation.[2]

Ripening is a kind of concoction (πέψις).[3] Owing to the mastery of fire, ripening occurs in every animal and plant and in metals (μετάλλοις), wherever moisture and heat each reaches its own proper limit, which is obvious with stone and metals but not in animals and plants, because their parts are not compacted into one as in stones, and also some moisture escapes.[4]

In concoction the constituent moisture is mastered and the thing becomes denser and hotter. Ripening is coming to maturity and the material becomes denser, some material being assimilated and some rejected. Boiling is concoction by moist heat; only things containing moisture which can be mastered can be boiled, stones and wood cannot; oil cannot be boiled of itself since it does not thicken; although gold is commonly said to be 'boiled' this is only metaphorical. Roasting is concoction by extrinsic dry heat.[5]

The effect of cold is inconcoction (ἀπεψία, *apepsia*), of which there are three kinds: rawness (ὠμότης, *omotes*), scalding (μόλυνσις, *molunsis*), and scorching (στάτευσις, *stateusis*).[6] These names are used to describe all kinds of chemical changes, no new technical terms being introduced. They were used in the Hippokratic *On Ancient Medicine*, which was perhaps the source, since Aristotle gives many medical examples. Scorching is the opposite of roasting; scalding of boiling, when the heat of the liquid is too small; rawness of ripening. The digestion (πέψις) of food in the body is similar to boiling; it takes place under the influence of the heat of the body in a hot and moist medium, and some forms of indigestion (ἀπέψις) are like scalding. Digestion takes place in the upper belly and the excrement decays in the lower.[7]

Decay or putrefaction (σῆψίς, *sēpsis*) is a particular but very common kind of passing-away (φθορά), in which a thing disintegrates or perishes in the ordinary way of nature (ὧν τὸ τέλος τῆς κατὰ φύσιν θφορᾶς σῆψίς ἐστιν). It is the destruction of the natural heat (σύμφυτον θερμόν) of a moist body by external heat.[8]

Solidification (ῥητέον, *rhēteon*) is a form of drying (ξηραίνεσθαί, *xērainesthai*) due to heat and cold, the opposite being liquefaction (ὑγραίνεσθαί, *hugrainesthai*).[9] Solution (λύεσθαι, *luesthai*) and melting (τῆξις, *tēxis*) are rarely distinguished.[10] If the pores of a body are too small for water to enter it is not dissolved, but soda (νίτρον), salt, and dried mud are dissolved by water but not by oil.

Anything earthy with pores larger than the particles of water (ὕδατος ὄγκων) is softened by water; soda has continuous pores and is dispersed at once by water, in earth the pores alternate. If the pores remain intact the body

[1] Reuvens, 10 f.; Hammer Jensen, *Hermes*, 1915, l, 119; Ideler, III (*c*), II, vii.
[2] XI, (i), iv, 441*a*; Ross, XI (*c*), 205.
[3] III, iv, 3, 380*a*. Olympiodoros, in a long comment, III (*c*), ii, 183–4, says: πέπανσίς ἐστι σύστασις καὶ πάχυνσις τῆς ἐν τοῖς περικαρπίοις ὑγρότητος . τουτέστι πέψις.
[4] ζ′, ii, 1, 822*a*.
[5] III, iv, 2, 379*b*–380*a*; iv, 3, 380*b*–381*a*.
[6] III, iv, 2–3, 379*b*–381*b*; Rolfes, (2), 216.
[7] III, iv, 3, 381*b*.
[8] III, iv, 1, 379*a*; Jaeger, *Hermes*, 1913, xlviii, 29 (43–55); Joachim, *J. Philol.*, 1903, xxix, 71.
[9] III, iv, 5–6, 382*a*–383*a*.
[10] III, iv, 6–7, 382*b*–384*b*.

softens; if they yield, it dissolves.[1] Clay gives up water on burning and hardens; it does not melt but softens only at an intense heat. Pyrimachos stone (ὁ λίθος ὁ πυρίμαχος) and millstones (μύλαι), perhaps pumice and lava, melt and solidify again on cooling, the latter becoming black but like lime (τιτάνῳ). These are insoluble and contain more earth than water.[2]

Gold, silver, copper, tin, lead, glass, and many kinds of stone which have no name, are composed of water (ὕδατος) and are melted by heat. Liquids such as some wines, urine, vinegar, lye, whey, and serum, are solidified by cold. Iron, horn, nail, bone, sinew, wood, hair, leaves, bark, amber, myrrh, frankincense, 'tears', stalactites, vegetables and corn, contain earth in varying proportions, for some can be softened by fire, others give off fumes and are produced by cooling; soda, salt, and those stones neither formed by cooling nor fusible are also earthy. Blood and semen are composed of earth, water, and air.[3]

Homœomerous bodies (ὁμοιομερῆ σώματα) are vegetable (wood, bark, etc.), animal (bone, flesh, and sinews), and mineral (metals, composed of water and earth and of their exhalations, and stones), have passive qualities (like moist and dry), by which they are differentiated. Aristotle defines eighteen pairs of these and their opposites:[4] solidifiable, meltable, softenable by heat or water, flexible, breakable, fragmentable, plastic, ductile, malleable, fissile, cuttable, viscous (with the opposite friable), compressible, combustible, and capable of fuming.[5] Transparent solids like glass have all the pores running in the same direction.[6] Things with alternating pores (ice and stone) fragment, those with long continuous pores (wood) break, those with both kinds (earthenware) both break and fragment. Compressible things have pores, either empty or full of softer material.[7]

Liquids not solidified by cold contain water but much air, as oil, quicksilver (ἄργυρος ὁ χυτός), and viscous liquids like pitch and birdlime (ἰξός).[8] Things which cold solidifies but does not thicken contain more water, such as wine, urine, vinegar, lye (κονία), and whey; those which thicken either contain more earth, such as honey, or more air, such as oil. Milk, blood, and liquids from which soda and salt are formed, contain more earth, and stones are formed from some similar liquids. The earthy part of milk can be coagulated by rennet, as the doctors curdle it. The whey boils away like water.[9]

Everything that has been burned (ashes, lime) contains more or less heat; the heat which destroys the natural heat produces worms in rotten material. The waste products of the human body decay when they lose their natural heat, and leave only their material factors (ὕλη), earth and water: ancient corpses sometimes suddenly turn to dust (τέφρα) in their tombs.[10]

Metals

Metals are cast (χυτά) or wrought (ἐλατά). They owe their fusibility to potential water, which on melting becomes actual. Except gold, which is perfectly pure and unchanged by fire, they also contain more or less earth; the

[1] III, iv, 8–9, 385*a–b*.
[2] III, iv, 6, 383*a–b*.
[3] III, iv, 10, 388*a*–389*a*.
[4] III, iv, 8, 384*a*–385*a*.
[5] III, iv, 8–9, 385*a*–388*a*.
[6] δ', xi, 58, 965*b*.
[7] III, iv, 9, 386*a–b*.
[8] III, iv, 5, 8, 10, 382*b*, 385*b*, 388*a*.
[9] III, iv, 7, 384*a*.
[10] III, iv, 10, 12, 389*a*, 390*b*.

more fusible (also glass and some minerals) like gold, silver, copper, tin, and lead, contain more water; the less fusible iron contains more earth.[1] Aristotle does not seem to mention the increase in weight on calcination, but the commentary of Olympiodoros[2] seems to suggest it for copper. Aristotle uses the same word (τήκεσθαι) for dissolving in water and fusion by fire, in which particles of fire penetrate between the pores, as particles of water penetrate the pores of a soluble thing. Whatever is 'soluble by fire' is mainly water.[3]

Gold is yellow and red like fire.[4] It has no smell because it has no taste; copper and iron have smell, which is less in the scoria (σκωρίαι) formed when the moisture is burnt out of them. Silver and tin have more smell than gold, copper, and iron, since they contain water.[5] This suggests that Aristotle regarded metals as composed of water and earth.[6] Theophrastos[7] (following Plato) regarded metals as composed of water (ὕδατος μὲν τὰ μεταλλεύμενα).

Aristotle discredits the story that the crane has inside it a stone for ballast, which when vomited up is a touchstone for gold.[8] At Philippi in Macedonia the refuse from mines grows and produces gold.[9] In Paionia, where the earth is full of gold, lumps of gold dug up are called 'unfired gold (χρυσόν ἄπυρον)' or 'uncoined gold (ἄσημον τι χρυσίον)'.[10] Gold is found in the River Oxus, Iberia, and Pieria in Macedonia.[11] The Chalybes cut up mice found in mines and collect gold from them.[12] Electrum (?) (ἤλεκτρον) is mentioned with gold and ivory.[13]

Silver is like tin;[14] it is purified by fire and may 'spit' (form bubbles) owing to the difficulty in the escape of heat from the dense metal.[15] Silver was found in enormous amounts in Tartessos in Spain by the Phoenicians, who cast anchors of it; it was discovered by its melting out of the ground during a forest fire.[16]

In Cyprus copper (χαλκός) is cut into small pieces and sown in the ground; when the rain comes it grows and puts out shoots (αὐξάνεται), and is collected.[17] Copper was found by divers under two fathoms of sea off the Carthaginian island of Demonesos.[18] Copper is smelted from chalcitis ore (ἡ χαλκῖτις λιθός καίεται) in Cyrpus.[19] It has great healing virtue; wounds made with copper (or bronze) weapons heal more easily than those made with iron.[20]

Copper and silver are not concocted by animal heat and not easily dissolved in the stomach.[21] The rust (ἰός) of copper has a medicinal action.[22] Copper heals bruises when applied to them (in the form of ladles) because it is cold.[23] Doctors use 'flower of copper (ἄνθει τοῦ χαλκοῦ)' as eye medicine.[24] The

[1] III, iii, 6, 378*a*; iv, 8, 10, 384*b*–389*a*.
[2] In Ideler, III (*c*), ii, 189: τοῦ δὲ ὀλίγα καὶ βαρύτερα γίνεσθαι τὰ ἑψόμενα παράδειγμα ὁ χαλκὸς ὁ κεκαυμένος . . . τοῦτο ἀποτιθέμενος ἐν τῇ καύσει, βαρύτερος γίνεται.
[3] III, iv, 6, 7, 382*b*–384*b*; Hoefer, NBU, iii, 222; A. E. Taylor, (1), 427.
[4] XII, *I* (ix), 3, 1054*b*.
[5] XI, (i), v, 433*a*.
[6] Rolfes, (2), 214, says of all four elements.
[7] *On Stones*, i, 1.
[8] V, viii, 12, 597*a*; for the touchstone, β′, iii, 16.
[9] γ′, 42, 833*a*.
[10] γ′, 45–7, 833*b*.
[11] γ′, 46–7, 833*b*.
[12] γ′, 26, 832*a*.
[13] ε′, vi, 398; Ideler, III (*c*), ii, 163.
[14] XII, *H* (viii), 3, 1043*b*; *I* (x), 3, 1054*b*.
[15] δ′, xxiv, 9, 936*b*. The bubbles are escaping oxygen.
[16] γ′, 87, 135, 837*a*, 844*a*.
[17] γ′, 43, 833*a*–*b*.
[18] γ′, 58, 834*b*; Beckmann, γ′ (*e*), 118.
[19] V, v, 19, 552*b*.
[20] δ′, i, 35, 863*a*.
[21] δ′, i, 42, 864*a*.
[22] δ′, ix, 6, 890*a*.
[23] δ′, ix, 10, 890*b*.
[24] γ′, 58, 834*b*.

minerals chrysokolla (χρυσοκόλλα) and kyanos (κύανος), found in the island Demonesos, as costly as gold, and used as eye medicines,[1] may be malachite and azurite, respectively.[2]

Bronze is formed by melting copper with tin, which disappears except for the colour it has given to the copper.[3] Copper is coloured with bile (χολοβαφίνα) to imitate gold.[4] Pliny[5] reports that Aristotle said that bronze was discovered by Scythes the Lydian, Theophrastos that it was discovered by Delas the Phrygian, but these statements are not in their extant works.

Chalybian and Amisenian iron grows from sand brought down by rivers. Some say this is simply washed and heated in a furnace, others that it is repeatedly washed and the residue heated with a fireproof stone (δὲ τὸν πυρίμαχον καλούμενον λίθον) found in the district. This iron is superior to all other kinds; if it were not burnt (ἐκαίετο) it would not be very different from silver. It alone is not liable to rust (ἀνίωτον) but there is not much of it.[6] The πυρίμαχος λίθος is said[7] to fuse to liquid drops on heating, becoming hard again on cooling. Beckmann[8] said it was not pyrites, since Theophrastos[9] suggests its use as a flux. It may have been fluorspar[10] or limestone.[11] The ore was perhaps an alluvial magnetite.[12] The Etruscan mines of Aithaleia [Elba] first yielded copper, then it went out of use and iron appeared from the same mine, which the Tyrrhenians [Etruscans] of Populonion still use.[13] In Cyprus mice eat iron.[14]

Aristotle knew of steel; he says that heat and cold soften and harden the 'iron' used for swords (σκληρὸν μὲν γὰρ καὶ μαλακὸν τὸν σίδηρον ποιεῖ τὸ θερμὸν καὶ τὸ ψυχρόν, ἀλλὰ ξίφος).[15] Iron is melted by heat (τακεὶς ὑπὸ θερμοῦ) and solidifies on cooling (ψυχθεὶς πήγνυται).[16] Crude iron (εἰργασμένος σίδηρος) will melt and soften and then solidify again (ὑγρὸς γίγνεσθαι καὶ πάλιν πήγνυσθαι), and this is how steel (στόμωμα) is made.[17]

White lead (ψιμμύθιον or ψιμύθιον) is mentioned[18] as a contraceptive, but its preparation is not described. It was known to Plato (see p. 66). Lead ore (μολύβδαινα) mixed with water and oil increases in bulk and changes from fluid and black to coherent (στιφός) and white, owing to admixture of air (πνεῦμα), which makes foam and snow (which is a foam) white.[19]

It is said (φασι) that Keltic tin (τό καττίτερον τὸν Κελτικὸν) melts more easily than lead, even in water, and even in cold frosty weather, because of the heat stored up and compressed in it (*antiperistasis*, see p. 90), because of its weakness (διὰ τὴν ἀσθένειαν); at any rate its surface is easily affected (χρώζει

[1] γ', 58, 834*a*. [2] Blümner, (1), iv, 296. [3] IV, i, 10, 328*b*; β', iv, 794*b*.
[4] *Sophistici Elenchi*, i, 14, 164*b*; B, i, 276; Blümner, (1), iv, 167; Isidore of Seville, *Orig.*, XVI, xx, 5; Pliny, xxviii, 40 (bile is used to colour copper, and other metals, like gold).
[5] vii, 57. [6] γ', 48, 833*b*; the place is in the Pontos; Blümner, (1), iv, 213.
[7] III, iv, 6, 383*b*. [8] γ'(*e*), 95–6. [9] *On Stones*, § 19.
[10] Beckmann, (1), 1846, ii, 90; Blümner, (1), iv, 220; Ideler, III (*c*), ii, 472.
[11] Hulme, *Trans. Newcomen Soc.*, 1938, xviii, 181.
[12] Pliny, xxxiv, 41; in Cappadocia.
[13] γ', 93, 837*b*. [14] γ', 25, 832*a*. [15] IX, ii, 1, 734*b*. [16] III, iv, 7, 384*b*.
[17] III, iv, 6, 383*a*–*b*; Ideler, III (*c*), ii, 53, 469; Lee, III (*e*), 324.
[18] V, vii, 3, 583*a*.
[19] IX, ii, 2, 735*b*; Peck, IX (*a*), 160, thinks this refers to the flotation process with galena, στιφός being the froth.

γοῦν, ὡς ἔοικε, ταχύ).[1] In the Amber Islands (ταῖς Ἠλεκτρίσι νήσοις) in the Gulf of the Adriatic there was a statue of copper and one of tin, said to be the work of Daidalos.[2]

Zinc is not mentioned. The Phrygian ash (τέφρα Φρυγία) used by doctors for the eyes,[3] and perhaps made at Laodiceia,[4] may have been zinc oxide.[5] The bronze (χαλκός) of the Mossynoikians[6] is very brilliant and light-coloured (λευκότατον), not because it contains tin but because some kind of earth is combined and smelted in it (ἀλλὰ γῆς τινὸς αὐτοῦ γινομένης καὶ συνεψομένης αὐτῷ). The discoverer did not reveal the process, which is lost.[7] This was probably brass, as was the Indian bronze like gold,[8] and ὀρείχαλκος (mentioned by Plato, see p. 66) used for making a statue at Demonesos, made from copper found two fathoms below the sea and brought up by divers.[9]

Liquid silver (ἄργυρος ὁ χυτός), not solidified by cold, containing earth and much water and air,[10] is mercury. Philippos the comedian says Daidalos made a wooden statue of Aphrodite capable of movement by pouring mercury into it (φησὶ γὰρ τὸν Δαίδαλον κινουμένην ποιῆσαι τὴν ξυλίνην Ἀφροδίτην, ἐγχέαντ' ἄργυρον χυτόν), which had been used as an argument that the soul moves the body, as Demokritos had said.[11] Cinnabar (κιννάβαρι), a red powder used as a colour,[12] is not associated with mercury (see Dioskourides, p. 190).

Non-Metals

Sulphur (θεῖον), which is divine (θεῖον),[13] has many colours according to the light, and these change on heating.[14] Ashes are salty and smell of sulphur (when wetted ?).[15] Sulphur (on burning ?) produces powerful odour,[16] and sulphurous fumes escape from the earth in Apollonia.[17] Animals are destroyed by the power of sulphur and bitumen,[18] perhaps the fumes on burning.[19]

The drug called sandaraké (σανδαράκη; arsenic disulphide, realgar) is extremely injurious to a horse and to all draught animals; it is given in water and strained through a colander (ὑπὸ φαρμάκου δὲ διαφθείρεται καὶ ἵππος καὶ πᾶν ὑποζύγιον σανδαράκης· δίδοται δ' ἐν ὕδατι καὶ διηθεῖτα; sandaracae veneno interit tum equus, tum jumenta omnia; datur autem in aqua atque

[1] γ', 50, 834*a*. This may refer to the conversion into allotropic grey tin by cold: E. Cohen, in Abegg, *Handbuch der anorganischen Chemie*, 1909, III, ii, 547.

[2] γ', 81, 836*a*–*b*.

[3] γ', 58, 834*b*.

[4] W. M. Ramsay, (1), i, 52.

[5] Blümner, (1), iv, 167.

[6] A people living near the Euxine, in the Black Sea region; Strabo, xii, 18, 548C, who, and Skymnos of Chios, GGM, i, 234, say they lived in towers in trees.

[7] γ', 62, 835*a*; Beckmann, γ' (*e*), 131; Schrader, (1), 539.

[8] γ', 49, 834*a*; γ' (*e*), 97.

[9] γ', 58, 834*b*.

[10] III, iv, 8, 385*b*.

[11] X, i, 3, 406*b*; 'molten silver', in Freeman, (1), 1949, 314, and C. Bailey, (1), 158, is clearly impossible; 'mercury' is given in B, iii, 437, and Hett, X (*d*), 36; 'automatic puppets' are mentioned in IX, ii, 1, 734*b*; iii, 5, 741*b*; no works of Philippos, who 'rationalised' the legend of Daidalos, remain, and nothing is known of his life or date; Means, DBM, iii, 289; Natorp, PW, iv, 2002. That mercury was mentioned by Aristotle before Theophrastos was emphasised by Berthelot, (3), 278, and Blümner, (1), iv, 98, long before Lippmann, (1), ii, 109; (2), i, 601.

[12] III, iii, 6, 378*a*; III (*c*), ii, 148; V, ii, 1, 501*a* (κινναβάρινον).

[13] δ', xxiv, 19, 937*b*.

[14] β', ii, iii, 792*b*, 793*b*.

[15] III, ii, 3, 358*a*; δ', xxiv, 18, 937*b*.

[16] X, ii, 9, 421*b*.

[17] γ', 127, 842*b*.

[18] XI (i), v, 445*a*.

[19] X, ii, 9, 421*b*: ἰσχυρῶν ὀσμῶν destroy a man; V, iv, 8, 534*b* (burnt sulphur and hartshorn, or gum styrax.

percolatur).[1] Since *sandaráke* is said elsewhere to be insoluble,[2] perhaps 'burnt' realgar is meant, the first reference to arsenious oxide,[3] but the text is very obscure.[4]

Arsenikon (ἀρσενικόν, *auripigmentum*) is orpiment (arsenic trisulphide), since it is said to colour hair red, and yellow orpiment mixed with milk of lime (κονία), was used for this purpose.[5]

A very obscure passage (probably badly translated from Arabic) says small plants grow in sulphurous places where strong winds meet and rouse the air in them to activity. The ground gets hot and fire issues from it, and after this orpiment appears, descending from the impurity of the air, and fire, coupled with putrescence, is attracted (for this is orpiment).[6]

Salt is more odorous than soda (λίτρον), as the oil which exudes from salt proves, but soda belongs more to earth (γῆς ἐστὶ μᾶλλον).[7] Salt and soda dissolve in water, which destroys what is made by heat and dryness.[8] Salt dissolves more easily in salt water than in fresh, because the thicker liquid penetrating into the pores disintegrates the solid.[9] Salt thrown on a fire makes a noise because it contains a little moisture which evaporates with the heat, and violently bursting forth rends the salt.[10] Small quantities explode more quickly, large quantities more violently; the same quantity thrown on a large fire makes less noise (or no noise at all) than when thrown on a small fire because it is burnt up before it can burst, its moisture being used up.[11] Salt in perspiration, tears, and urine comes from the food, the best and sweetest parts of which are retained by the body and the superfluous rejected.[12]

The upper layers of the sea are saltier and hotter than the depths because the sun and air attract the lightest part.[13] There is something fatty in salt water, and in hot weather an oily substance is excreted from the sea; sea water is combustible when thrown on a fire, and has less power to extinguish fire than fresh water because it is of a more fatty composition, and also because it is drier and hotter.[14] Salt water becomes drinkable when heated and cooled, for when it is heated the salt is boiled out and when it cools is precipitated.[15] Sea water tastes bitter as well as salty, since it contains various juices [magnesium salts].[16] It is warmer than fresh water and cools more slowly.[17] In Ituke in Libya opposite Carthage salt, buried at a depth of three fathoms, is white and soft like sticky gum but hardens in the sun and becomes like Parian marble; small figures and other objects are carved out of it.[18]

Soda (λίτρον) is fusible and soluble or is coagulated by heat like cream, and

[1] V, viii, 24, 604*b*.
[2] III, iii, 6, 378*a*; Lee tr. incorrectly 'infusible'.
[3] Lippmann, (1), ii, 102.
[4] Alexander of Aphrodisias, in Ideler, III (*c*), ii, 160; D'Arcy Thompson, in V (*e*), 604*b* reads διαφορεῖται for διαφθείρεται and thinks a diaphoretic like antimony sulphide is meant. In another place, V, ix, 40, 623*b*, 625*b*, σανδαράκη (or κήρινθος) is bee-bread.
[5] δ′, xxxviii, 2, 966*b*; Lippmann, (1), ii, 103, was off the track here; Theophrastos, *On Stones*, 40, 50, 51, spells it ἀρρενικον.
[6] ζ′, ii, 4, 826*a*; A, iii, 401 (Latin).
[7] XI, (i), v, 443*a*.
[8] XI, (viii), xiv, 477*b*.
[9] δ′, xxiii, 22, 934*a*.
[10] δ′, xi, 26, 902*a*.
[11] δ′, xi, 42, 43, 904*a*.
[12] III, ii, 3, 357*b*; δ′, ii, 3, 866*b*.
[13] δ′, xxiii, 30, 934*b*.
[14] δ′, xxiii, 9, 15, 932*b*, 933*a*.
[15] δ′, xxiii, 18, 933*b*.
[16] δ′, xxiii, 35, 935*a*.
[17] δ′, xxiii, 7, 932*b*.
[18] γ′, 134, 844*a*; Beckmann, γ′ (e), 302–3.

is astringent.[1] The 'foam (ἀφρα)' used in dyeing[2] is probably aphronitron (see p. 33). The bitter salt extracted from ashes (κονία) by water[3] would be potash. The water of the lake Askania gives soda, not salt, on evaporation; it can be used for washing clothes but they fall to pieces in it if left too long.[4] Ashes contain potential heat, which is given out when water is poured over them.[5] In Umbria ashes of reeds are lixiviated and the liquid evaporated and cooled, when 'salt' is copiously deposited.[6] What heat fails to master becomes sediment in living bodies (e.g. salt in urine, which concretes in chamber pots) and ashes in combustion (τοῖς καομένοις τέφρα).[7]

Alum (στυπτηρία) (which is white)[8] and vitriol (μελαντηρία)[9] are used in dyeing; they have sharp tastes and dissolve in water, communicating their properties to it.[10]

Fire

Plato[11] distinguished between heat and fire; Aristotle[12] gives as kinds of fire burning coals, flame, and light (ἄνθραξ, φλόξ, φῶς), flame being less subtle (λεπτομερέστατον) than light, and distinguished from the matter (σῶμα) of fire. In Aristotle ἐκπύρωσις (*ekpyrosis*) means 'combustion',[13] but ἐκπυροῦσα often has an active sense, burning something.[14] He had some idea of the difference between temperature and quantity of heat, although he calls both 'heat (θερμόν)'. A body is hotter if it parts with a greater amount of heat to a body in contact with it; of two masses of the same substance the larger has more heat than the smaller; a body is hotter which takes longer to cool; boiling water is hotter than a *small* fire. All these examples refer to *quantity* of heat.[15]

The substratum (ὑποκείμενον) of heat is smoke and charcoal (ἄνθραξ), and all things which have passed through the fire, such as cinder (κονία) and ash τέφρα); the excrement of animals, and bile (a residue) have heat left behind in them. Fir-wood and other fatty things are hot in another way, since they can quickly change into actual fire.[16] Fire never appears in its own specific form but always in a body, for the object on fire is air, smoke, or earth.[17] Fire is destroyed by: (i) dying out, a decay (μάρανσις) arising from itself by lack of nourishment; or (ii) extinguishing (σβέσις), a decay caused by opposites which prevents the fire from being fed by checking its assimilation. If heat in a living body is to be preserved, there must be some cooling down of the initial heat. If coals are covered continuously with a lid, which we call a choke (καλουμένῳ πνιγεῖ)[18] they are soon quenched [because the heat is kept in], but if the lid is

[1] δ′, i, 38, 863*b*. [2] β′, iv, 793. [3] III, ii, 3, 357*b*.
[4] γ′, 53; δ′, xxiii, 40, 935*b* (where the lake is Paisos); III, ii, 3, 359*a* (where the lake is in Palestine); W. M. Ramsay, (1), i, 298, says it is Buldur.
[5] III, iv, 11, 389*b*.
[6] III, ii, 3, 359*b*; Pliny, xxxi, 40, gives Theophrastos as the authority for this.
[7] III, ii, 3, 357*b*, 358*a*. [8] V, v, 15, 547*a*.
[9] β′, iv, 794*a*; Pliny, xxxv, 25 (*atramentum*).
[10] γ′, 127; δ′, xxiv, 18, 937*b*. [11] *Kratyos*, 413*c*.
[12] *Topica*, i, 5, 134*b*; vii, 7, 146*a*; III, i, 3–4, 340*b*–341*b*.
[13] III, i, 5, 342*b*.
[14] Eicholz, *Class. Quart.*, 1949, xliii, 141.
[15] VI, ii, 2, 648*a*–49*b*. [16] VI, ii, 2, 649*a*.
[17] III, i, 4, 341*b*; IV, ii, 4, 331*b*; VI, ii, 2, 649*a*; IX, iii, 11, 761*b*.
[18] In Aristophanes, *Clouds*, 96, πνιγεύς is a dome-shaped damper; Theophrastos, *De igne*, § 19.

lifted from time to time they remain alight for a long time [since they are cooled now and again]. A small flame is extinguished inside a larger flame, which robs it of nutriment.[1] A banked-up fire lasts a long time, since the fine ashes do not wholly exclude the external air but protect the fire from too much of it.[2] In respiration 'we emit fire with the breath'.[3] Aristotle had no idea that air plays a part in combustion.[4]

Combustible bodies have long pores which imbibe fire and do not contain too much water.[5] Wood, composed of earth and air, burns without melting,[6] woody materials, bones, hair, etc., give off fumes (*καπνός*, *fumus*), fat gives smoke (*λιγνύς*, *fuligo*), also pitch, oil, and wax, which are more inflammable when mixed with other things, but the fumes of oil are more properly called steam (*κνῖσα*, *nidor*). Inflammable bodies (*καυστῶν*) are those which produce flame, the most inflammable produce smoke, those containing more earth than smoke are carbonised (*ἀνθρακευτὰ*). Combustible bodies dissolve into ash (*εἰς τέφραν διαλύεται*).[7] Fire is generally thought of as combining and connecting as well as separating (criticising Plato). For though it separates bodies different in kind, it combines those which are the same; combining is essential to it, whilst separating is incidental.[8]

Flame is fire and flame is burning smoke (*μάλιστα μὲν γὰρ πῦρ ἡ φλόξ, αὕτη δ' ἐστὶ καπνὸς καιόμενος*),[9] or burning wind or smoke (*πνεῦμα ἢ καπνὸς καόμενός*),[10] and smoke is air and earth.[11] Fire is an excess of heat and a sort of boiling (*καὶ οἷον ζέσις ἐστὶ τὸ πῦρ*),[12] and flame is the ebullition of a dry current of air (*ἡ φλὸξ πνεύματος ξηροῦ ζέσις*).[13] Aristotle uses the plural adjective *φλογιστά* for 'inflammable' seven times in one place.[14] He seems to have thought that the two parts of fire, the hot and dry (solid) tend to separate, the solid combining with air to form smoke (air + much earth); hence fire comes to an end unless earth is provided by fuel to replace that lost as smoke; 'fire is like a river, ever flowing away and ever being formed anew.'[15] Lucretius[16] mentions that the smoke rising from the wick of a lamp (*lychnus*) just blown out may be kindled, when the flame runs down to the wick and relights the lamp. The same experiment, with a candle, is described by Van Helmont.[17]

The vapours from burning coals (*τῆς τῶν ἀνθράκων ἀτμίδος*) (carbon monoxide) cause headache and are often fatal to men.[18] In the island of Tenos, they say, there is a cup containing a mixture (*φιάλιον σύγκραμα*) from which fire is easily kindled.[19]

[1] Galen, and Francis Bacon, also thought flame (and sunlight) put out a flame; Ogle, XI (*k*), 27, 113–15.

[2] II, iii, 6, 305*a*; XI (vii), i–v, 469*b*–470*a*; XI (viii), viii, 474*b*; Aristotle says he discusses the matter in his *Problems*, and these contain several mentions of a large fire overpowering a less ('as fire to fire' was his favourite phrase): δ', i, 2, 860*b*; i, 16, 861*a*; iii, 23, 874*b*; iii, 33, 876*a*; iv, 28, 880*a*; xxii, 7, 930*b*; xxii, 12, 931*a*; xxiv, 13, 937*a*; xxxiii, 2, 961*b*; xxxiii, 8, 962*a*.

[3] δ', xxxiv, 12, 964*b*.

[4] Ross, XI (*c*), 302–4.

[5] III, iv, 9, 387*a*.

[6] III, iv, 7, 384*b*.

[7] III, iv, 9, 387*b*.

[8] II, iii, 8, 307*a*–*b*.

[9] IV, ii, 4, 331*b*.

[10] III, iv, 9, 388*a*; Galen, *De simpl. med. fac.*, i, 14; Kühn, xi, 406; *ἀὴρ μὲν γὰρ ἐκπυρωθεὶς φλόξ ἐστι, γῆ δὲ ἄνθραξ*; Gilbert, 198; Zeller, (1), II, ii³, 444.

[11] IV, ii, 4, 331*b*; XI (i), v, 443*a*.

[12] III, i, 3, 340*b*.

[13] III, i, 4, 341*b*.

[14] III, iv, 9, 387*b*.

[15] XI, (vii), v, 470*a*.

[16] vi, 900 f.

[17] *Ortus Medicinæ*, Amsterdam, 1648, 137.

[18] XI, (i), v, 444*b*.

[19] γ', 33, 832*b*.

Air

Although, it is said,[1] air is all the same, there are different kinds, some not suited to respiration.[2] Air cannot be condensed to a sensible body (ἔτι πολὺ ἧττον εὔλογον τὸ ἀέρα σωματοῦσθαι).[3] In very rapid motion through the air heat is generated by friction, and lead shots may be melted.[4] Conical vessels (κωνικά) which have been washed out with hot water (ὅταν θερμῷ διακλυσθῇ) draw up water into themselves when they are turned mouth-downwards in it.[5] Earthquakes are due to violent motions of air or wind (πνεῦμα) imprisoned in the earth and trying to find a vent; convulsions and cramps in the bowels are due to the same cause, 'if we can compare great things with small', and fire in volcanic activity is due to the ignition of vapours by rarefaction.[6] Thunder is produced by the impact of the dry exhalation on a cloud, and lightning by its ignition.[7] Aristotle uses the names πνεῦμα and ἄνεμος for 'wind', more rarely ἀήρ, which is atmospheric air composed of the dry and moist exhalations which come from the earth, while the other two are composed of the dry exhalation.[8]

Sound is produced by air being moved by contraction, expansion, and compression (αὐτὸν συστελλόμενον καὶ ἐκτεινόμενον καὶ καταλαμβανόμενον), also by knocking together by the striking of the breath and by musical strings, the motion striking the air and pushing it against the air next to it and so the motion extends in all directions.[9] Sound travels better at night because the air is not then set into tremulous motion by the heat of the sun.[10] Things kept in closed vessels remain without corruption because they are kept still.[11] A froth or foam is white because it is filled with tiny bubbles of air[12] and water itself contains pneuma.[13] Air seems blue because of its great dilution (διὰ τὴν ἀραιότητα).[14]

Aristotle says[15] 'everything in its proper place, except fire, has weight, even air (ἐν τῇ αὑτοῦ γὰρ χώρᾳ πάντα βάρος ἔχει πλὴν πυρός, καὶ ὁ ἀήρ). A proof of this is that a skin blown up with air weighs more than an empty one (ἕλκει πλεῖον ὁ πεφυσημένος ἀσκὸς τοῦ κενοῦ).'

In his commentary, Simplikios[16] says that Ptolemy (the geographer, d. after A.D. 161) in his (lost) book on weights (περὶ ῥοπῶν) had proved that air in its plenitude has no weight by means of a skin, with which he not only denied that the blown-up skin is heavier than the empty one as Aristotle says, but also asserted that it is lighter when it is inflated. 'I, however,' says Simplikios, 'have made the experiment with the greatest care, and found that the deflated skin has just the same weight as the inflated one.' The experiment is given in the earlier *Anonymus Londinensis* (see p. 186).

In speaking of the stratification of air below fire, Aristotle says: 'every particle

[1] δ′, i, 13, 860*b*. [2] *Topica*, v, 5, 135*a*. [3] XI (i), v, 445*a*. [4] II, ii, 7, 289*a*.
[5] IX, ii, 4, 739*b*; Aristotle does not connect this with cupping glasses (σικύα): *ib.*, 737*b*: *Poetica*, xxii, 1458.
[6] III, ii, 8, 365*b*–367*a*; Tozer, 198, says Aristotle was the first Greek to refer earthquakes and volcanoes to a common cause.
[7] III, ii, 9, 369*a*; Pliny, ii, 79. [8] Lee, in III (*e*), 203.
[9] η′ (i), 800*a*. [10] δ′, xi, 33, 903*a*, q. Anaxagoras.
[11] δ′, xxv, 17, 939*b*. [12] IX, ii, 2, 735*b*, 736*a*; v, 6, 786*a*.
[13] IX, iii, 11, 726*a*. [14] β′, iii, 794*a*.
[15] II, iv, 4, 311*b*; Ideler, III (*c*), 23; Hamy, *Chem. News*, 1869, xix, 119, 189 (air has weight); Rodwell, *ib.*, 123, 209 (doubtful); the transl. here is Prantl's, I (*f*), ii, 259.
[16] *De coelo*, 313*b*, 44K; ed. Heiberg, F, 1894, 710.

which is heavy sinks down (ἀλλ' ἀεὶ ὅ τι ἂν, βαρύνηται μόριον αὐτοῦ).'[1] If air has weight it is difficult to explain why inflated skins float on water whilst empty ones sink.[2] It seems doubtful whether Aristotle attributed weight to air.

The upper air is drier and contains a sort of fire (οἷον πῦρ), that of the lower region contains a moist vapour from water on the earth.[3] Yet water does not mix with air, and air escapes from water on standing without becoming moist, since air is lighter than water and always remains above it.[4] When rain falls, the hot element (τὸ θερμὸν) separates and rises to the upper region (εἰς τὸν ἄνω τόπον συνίσταται), the vaporous exhalation is cooled and condenses and becomes water (ἡ ἀτμὶς ψυχομένη καὶ γίγνεται ὕδωρ).[5] Porous stones float on water because the air in them rises and is attracted by the air above, for like always attracts like.[6] A dough of barley meal and water weighs *less* than its constituents, either because of evaporation of water owing to the heat in the meal or, less probably, because of the imprisonment of air in the mixture.[7] Leaven (ζύμη) swells up because its liquid part turns into air (πνεῦμα).[8] Divers have instruments through which they draw air from above the water and so remain for a long time under the sea;[9] they also breathe by letting down a cauldron, which does not fill with water but retains the air inside it.[10]

Water

Water does not rise above its level.[11] It and other liquids have few pores, since they are hardly compressible.[12] Boiling is caused by the wind (πνεῦμα) produced in water by fire.[13] In evaporation by cold the fluid accompanies the heat leaving, since there is no fluid without its heat.[14] Froths of air are white, and the vaporous air (ὁ ἀτμιδώδης ἀὴρ) enclosed in them makes all things white.[15] On heating, a liquid boils because the heat rising through it turns it into vapour.[16] The volume of vapour ('air') formed is much larger than that of the liquid, and water heated in closed vessels bursts them.[17] Steam or vapour is like air,[18] but on cooling turns again into water.[19]

Water may all freeze at one time but when much of it grows hot or freezes, each part is affected by the next, and it need not change all at the same time.[20] Dew is not produced by the cold of the stars (an 'absurd idea') but by loss of heat and moisture from the earth on a quiet clear night.[21] Hail is formed by sudden cooling of the rising vapour.[22]

[1] III, i, 3, 341*a*; Webster, C, 1931, iii, 341*a*, following Humboldt, (2), 1836, i, 126, supplied 'of air (τοῦ ἀέρος)' to 'particle'; Lee, III (*e*), 22, said 'of fire surely', but Aristotle did not attribute weight to fire.

[2] δ', xxv, 13, 939*a*.

[3] III, i, 3, 340*b*; ii, 4, 360*a*.

[4] δ', xxv, 3, 10, 11, 938*a*, 939*a*.

[5] III, ii, 4, 360*b*.

[6] ζ', ii, 2, 823*b*.

[7] δ', xxi, 18, 929*a*; Lippmann, (1), ii, 89 (with wrong ref.) says wrongly owing to 'escape of air'.

[8] IX, iii, 4, 755*a*; ζύμη is not 'yeast' as Peck, IX (*a*), 305, says, but 'leaven'; the process is called τοῦ δ' ὑγροῦ πνευματουμένου.

[9] VI, ii, 16, 659*b*; Ogle, VI (*c*), 181.

[10] δ', xxxii, 5, 960*b*; the diving bell.

[11] ζ', ii, 2, 823*a*.

[12] III, iv, 9, 386*a*–*b*.

[13] III, ii, 91, 370*a*.

[14] IX, v, 3, 783*a*.

[15] IX, v, 6, 786*a*.

[16] δ', xxiv, 9, 936*b*.

[17] I, iv, 9, 216*b*–217*a*; II, iii, 7, 305*b*.

[18] IV, ii, 3, 330*b*.

[19] I, ii, 8, 198*b*; III, i, 9, 346*b* f.

[20] I, viii, 3, 253*b*; XI (i), vi, 447*a*; thermal conductivity.

[21] III, i, 10, 347*a*; δ', xxv. 21, 939*b*; Gilbert, 501.

[22] III, i, 12, 347*b*; δ', xxvi, 3, 940*b*.

Stagnant water is green; rain water which has stood for a long time, as it dries up again (ἀποξηραινόμενον), becomes green, and in all growing things green is the first colour which obtains.[1] Pure water has no taste but, as Empedokles said, there is in water a universal germ-origin (πανσπερμία) of flavours, all of which are generated out of water.[2] Water from melted snow or ice is not healthy, since the lightest and purest parts escape on freezing.[3] The evaporation of large masses of water makes the climate warmer and protects plants from freezing.[4] Water when boiled deposits solid and becomes better for drinking.[5] Stalactites are formed in caves by cold, the heat and moisture being expelled together.[6] Stalagmites (στάλαγμων) are pillars joined to the floor in caves.[7] What is thrown into the river Ketos in Cumae, S. Italy, first grows a layer and after a long time becomes petrified (ἀπολιθοῦσθαι).[8]

Sea water changes spontaneously into earth and sand.[9] Hot springs are caused by water percolating into the hot interior of the earth.[10] They are thought to be healing because the heat is due to lightning that struck them, or from burning sulphur; some (e.g. in Magnesia) smell of lightning or sulphur, but the true cause is something dissolved out of the earth, such as alum, and the water also tastes of this.[11] Various kinds of mineral waters are sulphurous, hot and bitter, or aluminous.[12] Some springs are acid because the water contains alum.[13] Water filtering through the earth dissolves salt and becomes bitter, pungent, salty, or acid. Water at Sikania in Sicily is so sour that it is used instead of vinegar.[14]

Fresh water is lighter than salty, so that water on the surface may be sweet and drinkable, that lower down salty by infiltration, as in places in Africa. Since salt water is denser than fresh it is easier to float on it, and ships do not sink as deeply in it.[15] A lake in Palestine (the Dead Sea) is so salty that a man cannot sink in it, and so bitter and salty that there are no fish in it. An egg floats on water saturated with salt.[16] The surface of the sea is most salty because of evaporation.[17]

The sun draws up moisture but it is absurd to say that it is 'fed' by moisture,[18] or, with Empedokles, that the sea is the 'sweat of the earth' (ἱδρῶτα τῆς γῆς) (see p. 21) and hence is salty; or, with Anaxagoras (see p. 25), that this is due to dissolved earth; the saltness is really due to the dry (or smoky) exhalation from the land mixing with the moist exhalation and being carried down by rain.[19] The colour of clear sea water is blue.[20]

When salt water is heated, part of it is drawn up and becomes fresh, so that it descends in rain in a different form,[21] and the same thing happens in baths,

[1] β′, v, 794*b*.
[2] XI (i), iv, 441*a*; Hammond, (XI) (*e*), 165, thinks Anaxagoras rather than Empedokles.
[3] XIII, 206; A, v, 1515.
[4] δ′, xxiii, 34, 935*a*.
[5] δ′, xxiii, 18, 20, 933*b*; xxiv, 10, 937*a*.
[6] III, iv, 10, 388*b*.
[7] γ′, 59, 834*b*.
[8] γ′, 95, 838*a*.
[9] ζ′, ii, 2, 823*a*–*b*.
[10] III, ii, 8, 366*a*.
[11] δ′, xxiv, 17–19, 937*a*–*b*.
[12] δ′, xxiv, 17, 18, 19, 937*b*.
[13] III, ii, 3, 359*b*.
[14] III, ii, 1, 3, 353*b*, 357*a*–359*b*; XI (i), iv, 441*b*.
[15] δ′, xxiii, 20, 21, 27, 933*b*, 935*a*.
[16] δ′, xxiii, 13, 933*a*; ζ′, ii, 2, 824*a*; III, ii, 3, 358*b*.
[17] δ′, xxiii, 30, 934*b*.
[18] III, ii, 2, 354*b*–355*a*.
[19] III, ii, 3, 357*a*–358*b*; A. E. Taylor, (1), 425; see p. 96.
[20] IX, v, 1, 779*b*.
[21] III, ii, 3, 358*b*.

the 'salt' (dissolved matter) remaining and the fresh water condensing on the roof.[1] Aristotle says:[2]

> I have proved by experiment (*γίγνεται*) that salt water evaporated (*ἀτμίζουσα*) forms fresh and the vapour does not condense into sea water again. The same is true in other cases. For wine and other liquids which can be evaporated and subsequently condensed to liquid again become water on condensation (*καὶ γὰρ οἶνος καὶ πάντες οἱ χυμοί, ὅσοι ἂν ἀτμίσαντες πάλιν εἰς ὑγρὸν συστῶσιν, ὕδωρ γίγνονται*); for the qualities they have other than those of water are due to admixture (*μιχθέν*).[3]

Aristotle either did not try the experiment with wine, or he failed to notice that the condensate is not water but spirituous (alcohol). He repeats[4] that some kinds of wine, e.g. sweet wine (*οἷον τὸ γλεῦκος*), solidify when boiled and then it is the water that is driven off; the vapour collected is water (*ἡ γὰρ ἀτμὶς συνίσταται εἰς ὕδωρ*), and if there is any residue it is earthy.[5]

'Sweet wine' (probably must) does not taste like wine and does not intoxicate; it has a little fume and so emits a flame (*μικρὰν δ' ἔχει θυμίασιν· διὸ ἀνίησιν φλόγα*).[6] Alexander of Tralles[7] speaks of heating a mixture containing wine until 'the wine is used up (*ἕως ἂν ἀναλωθῇ ὁ οἶνος*).[8] Aristotle says wine is spirituous, especially black (*πνευματῶδες γὰρ ὁ οἶνος, καὶ τούτου μᾶλλον ὁ μέλας*),[9] and Athenaios[10] quotes from a treatise *On Drinking* by Aristotle that: 'if wine be moderately boiled, then when it is drunk it is less apt to intoxicate; for, as some of its power has been boiled away, it has become weaker (*τὴν γὰρ δύναμιν ἀφεψηθέντος αὐτοῦ ἀσφενεστέραν γίγνεσθαι*).'

Aristotle thus believed that sea water or salt water contains fresh water in a state of mixture (solution), and he gives a proof by an experiment:[11]

> Make a jar of wax and put it in the sea (*ἐάν τις ἀγγεῖον πλάσας θῇ κήρινον εἰς τὴν θάλατταν*), having closed its mouth so as to prevent the sea getting in. It will be found that the water which gets through the wax walls is fresh, for the earthy substance in admixture which caused the saltness is separated off as though by a filter (*ἀποκρίνεται*).

Since water will not pass through wax (*κήρινον*), Hoefer (1842) suggested[12] that *κεράμινον*, 'earthenware' should be read.[13] In another description of the

[1] ζ', ii, 3, 824*b*; text obscure. [2] III, ii, 3, 358*b*.

[3] Ideler, III (*c*), i, 82–3: Vinum namque et quotquot humores vaporantes rursus in humorem concrescunt, aqua efficiuntur.

[4] III, iv, 7, 384*a*.

[5] Düring, *Göteborgs Högskolas Årsskrift*, Göteborg, 1944, l, No. 2, 45, 86, read from a Paris MS. *σημεῖον δ' ὅτι ὕδωρ*, 'vapour condenses into water when collected', and calls the process 'distillation'.

[6] III, iv, 9, 387*b*; Berthelot, (4), i, 137, thought it was an alcohol flame, but this is doubtful; the flame from wine was mentioned by Hippokrates (see p. 34) and by Hippolytos.

[7] (1), ii, 350.

[8] Eisler, (3), 144, read *οἶνον ἐκδιώκειν*, 'driving off wine' (not in the text) and thought this meant distillation, but the words do not mean this.

[9] XI (iii), iii, 457*a*. [10] *Deipn.*, x, 34. [11] III, ii, 3, 359*a*. [12] (1), i, 99; (2), i, 96.

[13] Repeated, without mention of Hoefer, by Kopp, (1), 1843, i, 27; Diels, *Hermes*, 1905, xl, 301 (310: 'ein falsches Experiment'); Gilbert, 424; D'Arcy Thompson, V (*f*), 590*a* ('I have been at pains to perform the experiment, but in vain. Dr. Ogle suggests *κεράμινον* for *κήρινον*; but the latter, though highly suspicious, is supported by the parallel passages'); Lippmann, *A. Nat.*, 1910, ii, 233; *id.*, (1), ii, 98 (claiming priority); *id.*, *Chem. Ztg.*, 1911, xxxv, 629, 1119 (in (1), ii, 157, 162) (describing expts.); Brieger, *ib.*, 1918, xlii, 302 (crit. Lippmann); Lee, III (*e*), 158–9 (wax); Düring, *Göteborgs Högskolas Årsskrift*, Göteborg, 1944, l, No. 2, 76 (adopts *κεράμεον*, crediting Lippmann, who found that the experiment succeeds only with an

experiment Aristotle says[1] that if a thin wax vessel is let down empty into the sea by a cord (a wax vessel would actually float), after twenty-four hours it will be found to contain a quantity of fresh and drinkable water.

Aristotle himself[2] says water trickles through 'raw' (unglazed ?) earthenware (διαπιδύουσα . . . καθάπερ ἐν τοῖς ὠμοῖς κεραμίοις τὸ ὕδωρ), and that salt water becomes drinkable by being filtered (διηθούμενον γὰρ γίγνεσθαι τὸ ἁλμυρὸν πότιμον).[3] Baptista Porta[4] quotes Solinus (*c.* A.D. 200) as saying that sea-water is made fresh if filtered through clay (*argilla si percoletur*).

Aristotle's ideas on the formation of fresh water by the evaporation of sea water are more correct than the old Greek theory, probably due to Hekataios (*c.* 520 B.C.),[5] that salt water is made sweet by the heat of the sun, 'for it is of the nature of fire to make all water sweet (τοῦ πυρώδους πᾶν τὸ ὑγρὸν ἀπογλυκαίνοντος)' by evaporating the saline ingredients.[6] As Borrichius[7] said, Aristotle was near (*proxime*) the discovery of distillation.

Colours

The visible is colour (ὁρατὸν δ' ἐστὶ χρῶμά) but also something for which there is no single definite name [phosphorescence], which is seen in shining fungus (μύκης), horn (κέρας), and the heads, scales, and eyes of fish.[8] The two fundamental colours are black and white, which on surfaces correspond with darkness and light. From these are formed seven primary colours: white (λευκόν), black (μέλαν, including grey, φαιόν), yellow (ξανθόν), red (φοινικοῦν), purple (ἁλουργόν), green (πράσινον), and blue (κυανοῦν).[9]

The Peripatetic 'On Colours (*De coloribus*)' is in six chapters.[10] The first deals with the 'simple' colours of the elements. Air and water when pure are by nature white; fire and the sun yellow; earth naturally white but taking various colours by tincture (βαφή). Black is due to bodies naturally black or to deprivation of light. Black belongs to the elements of things when they are undergoing a transformation of their natures,[11] as when air and water are thoroughly burnt by fire; hence the blackest smoke is given off by grease, oil, and pitch.

The second chapter explains how other colours arise by the blending of primary colours in various proportions. Black mixed with light (σκιερόν) gives crimson (φοινικοῦν), seen in smoky flame on glowing charcoal;[12] feeble sunlight mixed with thin dusky white gives purple (ἁλουργὲς), as at sunrise

unglazed earthenware pot if the pores are previously filled with fresh water, which is forced nside by pressure).

[1] V, viii, 2, 590*a*; Pliny xxxi, 37 (wax); Ailian (*c.* A.D. 170–235), *Animal. Hist.*, ix, 64 (ἀγγεῖον ἐκ κηρου); *id.*, ed. Schneider, Leipzig, 1784, 310, tr. 128 (*e cera vas*); Ailian says Demokritos first stated that fish turn salt water into fresh, and attributes the experiment to Aristotle); Diels, *op. cit.*; Freeman, (1), 1949, 192 (Empedokles ?); Al-Bīrūnī (A.D. 1000), (1), 240 (from an Arabic text).

[2] IX, ii, 6, 743*a*. [3] III, ii, 2, 354*b*.

[4] *Magiæ Naturalis*, bk. xx, ch. 1; Leyden, 1650 ,647.

[5] Reported by Diodoros Siculus, i, 40; tr. Hoefer, Paris, 1846 (1865), i, 50.

[6] Tozer, 1897, 63. [7] (1), 1668, 93.

[8] X, ii, 7, 418*a*–419*a*; *κέρας may* mean the antennae of a crustacean: V, iv, 2, 526*a*.

[9] XI (i), iii, 439*b*–440*b*; iv, 442*a*–*b*; cf. I, i, 5, 188*a*–*b*; v, 5, 229*b*; XII, *I* (x), 7, 1057*a*; Ross XI (*c*), 206, makes eight by separating grey, as in Theophrastos, *De caus. plant.*, VI, i, 2.

[10] Text, A, 791–9; B, iii, 643–54; β' (*b*), (*d*).

[11] β', i, 1, 791*a*: the alchemical theory. [12] Also in III, iii, 4, 374*a*.

and sunset, or waves of the sea, or birds' wings extended against the light. The true way of investigating colour blends is not by mixing pigments as painters do, but by considering the rays of light reflected. Purple (τό ἀλουργόν) and crimson (τό φοινικοῦν) are distinguished.[1] Coal, rust (ἰός), and sulphur change colour when heated; smoke in the rays of the sun.[2]

The third chapter explains changes of colour. Metals (silver, gold, copper, and iron) often change colour when polished or powdered. Some black stones give white lines when rubbed. 'When the colouring matter is dissipated they all appear black.'[3] In rubbing on the touchstone (πρὸς τὰς βασάνους) they [metals ?] lose their blackness and recover their colour. No colour is ever seen in absolute purity but is always mixed with others or with light or shadows.

The fourth chapter deals with coloration by 'tincture' (dyeing), 'when one thing takes its colour from another (τὰ δὲ βαπτόμενα πάντα τὰς χρόας ἀπὸ τῶν βαπτόντων λαμβάνει)'.[4] Common dyes are flowers and plants and their roots, bark, wood, leaves, or fruit, together with (ἔτι δὲ πολλὰ) earth (or ashes ?) (γῆ), soda (ἀφρός, probably contracted from ἀφρονιτρον), lime (κονία), sea-water (θάλαττα) and vitriol (μελαντηρία).[5] Animal juices, as that of the purple fish (πορφύρα), are also used. When fleeces are dyed black the pores of the skin take up the colour but not the spaces between the hairs, which remain white. In dyeing, the colour passes into the pores. Steeping in alum produces many differences and mixtures, and so do the qualities of the substances dyed (πολλὰς δὲ καὶ αἱ στύψεις ἐν τῇ βαφῇ ποιοῦσι διαφορὰς καὶ μίξεις).[6]

The fifth chapter deals with the changes of colour in plants and in the maturing of fruits. When fruit ripens, 'each species takes its colour from its own juice, just as dyed material takes the hue of the colouring matter in which it is steeped.' The dye of the purple fish on boiling is first brown and black and dull, but then the vivid purple appears. Yellow is the final colour for leaves, corn, etc., since they dry up before they have had time to take their natural colours.[7]

The sixth chapter deals with the colours of animals. Practically all gaily-coloured birds such as peacocks start by being black.[8] The treatise ends by saying that an investigation into the theory of colours (τὰ χρώματα θεωρίαν) could be based on the information collected in it.

When the Euxine is 'purged' a substance called *phukos* (φύκος) is carried into the Hellespont and this substance is of a pale yellow colour. Some say it is the flower of the *phukos* from which rouge is made. Some say the sea purple (murex) gets its colour from it.[9] Purple is coloured by the murex (τὸ ἁλουργὲς τῇ πορφύρᾳ),[10] and the sepia, octopus, and calamary have bags containing black ink (θολός), which contains much earthy matter.[11] The murex has a

[1] β′, ii, 792*a*; Ross, XI (*c*), 198; ἁλουργές is the genuine 'purple', deep red; LSJ, 73.
[2] β′, ii, 792*b*. [3] β′, iii, 793*a*. [4] β′, iv, 794*a*.
[5] β′, iv, 794*a*–*b*; the passage is very obscure; perhaps the use of (i) dyestuff and (ii) mordant is intended.
[6] β′, iv, 794*a*. [7] β′, v, 794*b*–797*a*. [8] β′, vi, 797*a*–799*b*.
[9] V, vi, 13, 568*a* (D'Arcy Thompson's reading); the φύκος as a sea-weed yielding a rouge or purple dye is mentioned by Theophrastos, *Hist. plant.*, IV, vii, 4; and Pliny, xiii, 48; xxvi, 66; Partington, (1), 139, 156, 463, 496.
[10] β′, iv, 794*a*. [11] VI, iv, 5, 679*a*.

particular organ called a flower (ἄνθος), containing more or less of a juice, which when pressed out has little colour but reddens the hands (ἀνθίζει τὴν χεῖρα). It is cut open and the liquid drained from it and boiled in vessels. At first it becomes black, white, dull, and misty, but finally all becomes purple.[1] Purple is expensive and fraud is practised with the balance in weighing it.[2]

Light

Aristotle says Demokritos was right in saying vision is 'of water' (in the eye), but it is really in the diaphanous (ἀλλ' ᾗ διαφανές), and this is also common to air. Light is 'the colour of the diaphanous *per accidens* (ἐστὶ χρῶμα τοῦ διαφανοῦς κατὰ συμβεβηκός),[3] or a movement of the diaphanous:[4] (ἐστι τοῦ κατ' ἐνέργειαν διαφανοῦς) probably not a local movement (φορά) but a qualitative change (ἀλλοίωσις). Light is not a movement in a medium, like sound or odour, but is 'the activity of the diaphanous as such (φῶς δὲ ἐστιν ἡ τούτου ἐνέργεια τοῦ διαφανοῦς ᾗ διαφανες)', an instantaneous illumination of the region of air by fire; 'the colour of the diaphanous (χρῶμά ἐστι τοῦ διαφανοῦς)'; its transmission is instantaneous, or rather, it does not move at all.[5]

The medium has a positive state when it is illuminated and we say there is light, and a negative state when we say there is darkness. 'When there is an igneous body (πυρῶδες τι) in the diaphanous we have light, when not, darkness . . . the diaphanous does not belong exclusively to water, air, and other translucent bodies; it is some common nature or force (κοινὴ φύσις καὶ δύναμις) not existing separately but in these and other bodies, more or less.' Colours arise from combination of white and black, those depending on proportional numbers are harmonious, such as purple or scarlet.[6]

Organic Materials

In Media, Psittakos, and Pamphylia there are fires burning, the first two visible by day and night, the third only at night. That at Psittakos is large and the king built his kitchen near it.[7] The stone in Thrace called *spinos* (σπίνος) burns when split in half, and joined together again and sprinkled with water. The stone named *marieus* (μαριεύς) does the same.[8] The river Pontos in Thrace rolls down certain stones which burn (καίονται) and behave in the opposite way to charcoal made from wood, for when the flame is fanned these stones are quickly quenched, but when soaked in water they light up and kindle finely (ἀναλαμπουσι καὶ ἀνάπτουσι κάλλιον). When they burn they have a smell as unpleasant and acrid (δριμεῖαν) as pitch, so that no reptile can stay in the place where they are burning.[9]

[1] V, v, 15, 547*a*; β′, v, 795*b*.
[2] α′, i, 849*b*.
[3] XI (i), ii, iii, 437–9; Hammond, (1), xxxix; Lewes, 247 f.
[4] X, ii, 7, 418*b*–419*a*; Hicks, X (*b*), 364–7.
[5] X, ii, 7, 418*b*; Ross, XI (*c*), 223–4. Lewes thought the 'movement in the diaphanous' was 'a kind of undulation in an elastic ether', but this is not quite what Aristotle meant.
[6] XI (i), iii, 439–40; Lewes, 249.
[7] γ′, 35, 833*a*; probably natural gas.
[8] γ′, 33, 41, 832–833*a*; the Vienna MS. used by Beckmann (γ′(*e*), 83) and two others have μαριθάν, for which Salmasius suggested νάφθαν, Sylburg θρακίαν: Dowdall, C, vi, 833.
[9] γ′, 115, 841*a*; Beckmann, γ′(*e*), 258, thought bituminous shale containing pyrites; Pliny, xxxiii, 30, and Nikandros, *Theriaka*, 45, say it is kindled by water but extinguished by oil.

Oil is thickened both by heat and cold because it is full of air (ἀέρος ἐστὶν πλῆρες), which is why it floats on water. Cold turns this air into water, for when oil and water are mixed the thickness (παχύτερον) is greater than that of either oil or water.[1] Cedar oil[2] and 'seven-oil' (ἑπτὰ ἔλαιον) from terebinth and like olive oil,[3] are mentioned. Bear fat (στέαρ) when it solidifies in winter swells and overflows containers.[4] Beeswax (κηρός), collected from flowers, and stop-wax (κόμμωσιν) from exudations of trees,[5] are bleached in the sun like olive oil,[6] which then deposits a dark earthy part and the excess of moisture separates.

In Sicily (?) there is a spring of oil smelling like cedar cuttings.[7] Thick, dark, and viscous oils, with pitch and asphalt, stream from hot, sometimes burning, soil in Macedonia, Thrace, and Apollonia, smelling of sulphur, alum (στυπτηρία) and bitumen (πέφυκε).[8] In an island (Balearic) off Spain oil is made from the terebinth tree instead of olives.[9]

In some parts of Cappadocia, honey of the consistency of oil is made without wax,[10] and in Lydia and Thrace it is collected from trees (manna ?).[11] Honey drops from the air, particularly when stars rise and the rainbow sets, and bees collect it. Thyme honey is very sweet. All honey after a time becomes solid.[12] At Trebezond in Pontos honey from the box-tree (πύξος) has a heavy scent; it makes healthy men mad but cures epileptics immediately.[13] Rice-wine (οἶνος ὀρύζης) is given to sick elephants.[14] The Taulantii in Illyria make wine [mead] from honey mixed with water, boiled to half in a cauldron, and fermented in earthenware jars for a long time till it becomes vinous, sweet, and strong (εὔτονον). This was also known to the old Greeks but in later times the mixture (κρᾶσις) was lost.[15] *Κόμι Ἀραβικόν*[16] is gum arabic.

The lynx conceals his urine because it is used for many purposes, especially for making seals (σφραγῖδας).[17] Elektron (τό ἤλεκτρον) (amber) is a gum oozing from poplar trees and hardening like a stone in the islands of Elektrides in the Adriatic.[18] Amber (which contains entrapped insects), and substances called tears (δάκρυα), such as myrrh, frankincense, and gum (κόμμι), all formed by cooling, are composed of earth from which all the moisture has been evaporated along with the heat.[19] The 'plant' growing in the Red Sea[20] was probably coral, first definitely named (κουράλιον) as a sort of stone by Theophrastos[21] and Dioskourides.[22]

Veratrum, elaterium, scammony and thapsia are drugs.[23] Cinnamon (κιννάμωμον) is found in sticks in birds' nests, which are shot down with

K. C. Bailey, (1), i, 209, says Philemon Holland translated 'coal'; Dana, (1), 753 ('mineral coal'). It is mentioned by Dioskourides, v, 147.

[1] III, iv, 7, 383*b*; IX, ii, 2, 735*b* (air (πνεῦμα) is warm).
[2] V, vii, 3, 583*a*. [3] γ', 88, 837*a*. [4] γ', 67, 835*a*.
[5] V, v, 22, 553*b*–554*a*; ix, 40, 623*b*; D'Arcy Thompson's note in V (*f*).
[6] δ', xxxviii, 1, 11; 966*b*, 967*b*. [7] γ', 113, 841*a*. [8] γ', 114, 127, 841*a*, 842*b*.
[9] γ', 88, 837*a*. [10] γ', 17, 831*b*. [11] γ', 19, 831*b*. [12] V, v, 22, 554*a*.
[13] γ', 18, 831*b*.
[14] V, viii, 26, 605*b*; note in V (*e*). Ailian, *Nat. Animal.*, xiii, 8; rice, ὄρυζον, is first mentioned as an Indian plant by Theophrastos, *Hist. Plant.*, IV, iv, 10; Lenz, (2), 229.
[15] γ', 22, 822*a*; γ'(*e*), 51–2.
[16] ζ', i, 3, 818*a*; Müller, PW, ii, 355.
[17] γ', 76, 835*b*. [18] γ', 81, 836*b*; γ'(*e*), 163–6. [19] III, iv, 10, 388*b*.
[20] ζ', i, 4, 819*b*. [21] *On Stones*, § 38. [22] v, 139. [23] δ', i, 41–3, 864*a*.

arrows tipped with lead.[1] Poppy (μήκων), mandragora (μανδραγόρας), and darnel (αἶραι) are narcotic, since their vapours rise to the brain[2]. The plomos (πλόμος) used to catch fish,[3] was perhaps mullein (*verbascum*) or spurge. Ants are driven away by fumigation with styrax.[4] The Keltic arrow poison (φάρμακον τοξικόν) spreads so quickly that when an animal is shot the hunters hastily cut out the wounded flesh, both for the sake of the food and to prevent the body from putrefying: oak bark and ravenswort (hawkweed) are said to be antidotes.[5] The Scythians make this poison from putrid vipers mixed with human blood, and allowed to putrefy in a pot set in a manure heap.[6]

The torpedo fish (νάρκη) benumbs by the power of the shock residing in its body (τῷ τρόμῳ ὃν ἔχ ἐν τῷ σώματι).[7] Theophrastos says the shock passes through wood and harpoons (tridents) and benumbs those holding them.

Organic bodies such as plants and parts of animals are all formed from the four elements.[8] Aristotle[9] clearly distinguished material constituents (bone, flesh, etc.) from the living body. 'Woody things (ξυλώδα σώματα)' all smoke on burning, including bones, hair, etc.; Empedokles had classed together hair, leaves, feathers, and scales.[10]

The *De Partibus Animalium* deals[11] with blood, fibres, and lymph, also with fat, brain and marrow. The fibres are earthy, the lymph watery and serving to form blood.[12] The flesh (σαρκός) is the true body (σῶμα καθ' αὑτό),[13] and the organ of the sensation of touch. The bones protect the soft parts and are compared with the veins.[14]

The description[15] of carding a cocoon (βομβυλιός) and weaving fabric from the threads, an invention of a woman Pamphilia of Kos, was thought[16] to be the first Greek mention of silk, but the product was probably like the Indian tussore and not a product of the true silkworm.[17] The 'byssos' of the Pinna fish[18] is a tanned protein.[19]

Biology

Aristotle's biology has been praised.[20] His physiology was largely conjectural,[21] but goes further than Plato's *Timaios* in rudimentary organic chemistry. Aristotle introduced the idea of a 'ladder of nature', extending from inanimate things through plants and zoophytes to animals and finally man: 'Nature proceeds little by little from lifeless things to animal life in such a way that it is impossible to determine the exact line of demarcation.' He had no

[1] V, ix, 13, 616*a*. [2] XI, (iii), iii, 456*b*. [3] V, viii, 20, 602*b*.
[4] V, iv, 9, 534*b*. [5] γ', 86, 837*a*.
[6] γ', 141, 845*a*; Strabo, XVI, iv, 10, 771C, says a tribe in the Arabian gulf shot elephants with large arrows dipped in serpent gall.
[7] V, ix, 37, 620*b* (D'Arcy Thompson in V (*f*) reading σώματι for στρόματι). Theophrastos, Fr. 178 (from Athenaios, vii, 95); *Opera*, ed. Wimmer, Paris, 1866, 461.
[8] IV, ii, 7, 334*a*. [9] III, iv, 12, 389*b*–390*b*. [10] III, iv, 9, 387*b*.
[11] VI, i, 4, 650*b* f. [12] VI, i, 5–7, 652*a* f. [13] VI, i, 8, 653*b*.
[14] VI, i, 9, 654*b* f. [15] V, v, 19, 551*b*. [16] Blümner, (1), i, 191.
[17] D'Arcy Thompson, V (*f*), 551*b*; Yates, DA, ii, 649.
[18] V, v, 15, 547*b*; Bochart, (1), i, 490.
[19] Needham, (1), i, 200.
[20] Hicks, X (*b*), xlii; Singer, (1), 18, 22, 37; (3), 39 f.; Ogle, XI (*k*), introd., 29; Lewes, 186–375, thought it was over-rated.
[21] Lewes, 171–81; Sprengel, (1), i, 404.

theory of evolution.[1] Aristotle divided natural things primarily into: (i) inorganic or non-living, without soul (τὰ ἄψυχα), and (ii) organic or living, with soul (τὰ ἔμψυχα, ζῷα), although the difference in nature is small (μικρὸν ἡ φύσις). This division was more general than that into the 'three kingdoms of nature', animal, vegetable, and mineral,[2] but he divided plants and animals according to the nature of the soul, and so implicitly recognised the three kingdoms. Aristotle's 'scale of nature' was familiar to the Muslims, e.g. al-Mas'ūdī (10 cent.).[3]

The root of the plant is its head (κεφαλὴ ἡ ῥίζα ἐστὶ),[4] and hence plants take their nutriment from the earth.[5] In a strange locality they take after the soil (κατὰ τὴν χώραν), since this provides the material of the seeds.[6] Earth does not perceive, hence plants, composed of earth (they grow from the earth), have no sensation.[7] The nutriment of plants is water mixed with earth,[8] and everything that feeds requires heat and cold, found in dry and wet foods.[9] Plants belong to the earth, aquatic creatures to the water, and land animals to the air; a fourth tribe, belonging to the region of fire, may belong to the moon.[10]

Eggs are hatched in Egypt by burying them in dung-heaps, the heat of which hatches them.[11] Aristotle[12] speaks of creatures like large flies, engendered in fire (γίνεται θηρία ἐν τῷ πυρί) in copper smelting furnaces in Cyprus, which walk and fly about in the flames (διὰ τοῦ πυρὸς πηδᾷ καὶ βαδίζει) and also salamanders which can even extinguish fires.[13] There are many references to spontaneous generation.[14] Mould is putrefied vapour; plants are formed from dew, from which arise the forms of seeds through the power of the stars; worms are generated in snow, and fungi, truffles, etc., in putrescent soil.[15] Even the spontaneous generation of men in the earth is possible.[16]

In discussing vision, Aristotle sometimes[17] speaks of a visual ray (ὄψις) from the eye being weakened as it extends to the stars, but this was the popular theory;[18] his own opinion[19] was that in seeing we take something in and do not give something out (εἰσδεχόμενεί τι, οὐκ ἐκπέμποτες). He assumed three hypothetical media: (i) for light, the transparent (διαφανές); and two unnamed ones for smell and hearing, later called (ii) the transolent (διόσμον) and

[1] V, viii, 1, 588*a–b*; VI, iv, 5, 681*a*; IX, ii, 762*a*; X, ii, 3, 414*a–b*; ζ', i, 1, 816*b*; Zeller, II, ii, 431, 506; A. Buckley, *A Short History of Natural Science*, 1883, 16; Hicks, X (*b*), xlv; Ross, (1), 114.

[2] Hammond, X (*h*), xviii, xxix; Lewes, 1864, 190.

[3] *Le Livre d'Avertissement*, tr. Carra de Vaux, 1896, 164 f.: 'comment ces êtres sont ordonnés dans l'universe et liés les uns aux autres'; Silvestre de Sacy, *Le Livre de l'Indication et de l'Admonition*, in NEM, 1810, viii, 132, repr. in Mas'ūdī, *Les Praires d'Or*, tr. Barbier de Meynard, 1877, ix, 301–76.

[4] XI (vi), vi, 467*a*.

[5] XI (vii), i, 468*b*.

[6] IX, ii, 4, 738*b*.

[7] X, iii, 13, 435*b*; ζ', i, 1, 815*b*; Plato believed that plants have sensation.

[8] IV, ii, 8, 335*a*; Zeller, (1), II, ii³, 510.

[9] ζ', i, 1, 816*b*.

[10] IX, iii, 11, 761*b*.

[11] V, vii, 2, 559*b*; Diodoros Siculus, i, 74.

[12] V, v, 20, 552*b*.

[13] IX, v, 4, 784*b*; Peck, IX (*a*), 352.

[14] E.g. V, v, 1, 539*a–b*; v, 15, 547*b* (oysters, cockles, all testaceans), 19, 551*a*–552*b* (insects, worms in vinegar), 31–2, 557*a–b* (lice, clothes moth); vi, 15, 569*a–b* (fish from mud or sea foam), 16, 570*a* (eels in mud); Lippmann, (4), 8–11 and refs.; Ross, (1), 77, 117; Zeller, (1), II, ii³, 524.

[15] ζ', ii, 3–4, 824*b*–825*b*.

[16] VI, iii, 11, 762; Rolfes, (2), 266 f.

[17] II, ii, 8, 290*a*; III, iii, 4, 373*b*.

[18] Plato, *Meno*, 76*C–D*, q. Empedokles.

[19] *Topica*, i, 13, 105*b*.

(iii) the transsonant (διηχές), the organs being the eye, nose, and ear, respectively.[1] Tastes are sweet and bitter combined. Water filtered through the earth takes up something, as is seen in salt waters, for salt is a kind of earth, and water filtered through ashes (διὰ τῆς τέφρας) is bitter. Smells are transmitted by the diaphanous, air or (for fish) water; odour is a dry flavour conveyed by moisture in air or water. All sapid bodies are odorous (which is wrong, salt is not).[2]

Book ii of Aristotle's *De Anima* deals with vision, hearing, smell, taste and touch; book iii proves that there are only five senses; touch is the only one indispensable, the others existing in higher animals in order that they may 'live well'. Sound[3] is transmitted through air or water. A vacuum (κενός) is 'the lord of hearing (κύριον τοῦ ἀκούειν), for the air appears to be a vacuum and when moving continuously creates hearing'. Food enters the organs allotted to its reception, an 'evaporation (ἀναθύμιασις)' occurs into the veins, where it is transformed into blood and carried to the heart. What is evaporated and warm rises to the head, and then turns back. 'As the moisture evaporated by the sun's heat, on reaching the upper air is chilled by the cold air there, and falls back as rain, so the vapours of food reaching the cold brain become condensed and fall back again as mucus, but the non-noxious nutritive part descends and tempers the heat of the body.' This produces sleep.[4] A similar explanation was given by Hippokrates,[5] and the process of reflux distillation, with the cold brain acting as a condenser, was ridiculed by Van Helmont.[6]

The function of the brain (which he thought had no blood) was mistaken by Aristotle, who put the seat of sensation in the heart, and, unlike Plato (see p. 63), did not relate the spinal cord with the brain. The brain, composed of water and earth, is the coldest part of the body and serves to refrigerate the hottest part, the heart. He says some, e.g. Hippokrates, located the seat of sensation in the brain, because the chief organs (eyes, ears, nose, tongue) of sensation are in the head.[7] Roger Bacon[8] reconciled the two views by saying that the sensitive soul has two instruments, (i) the heart, which is radical and fontal, and (ii) the brain, which is first affected by sensible species; he quotes Avicenna as agreeing with Aristotle, but only in a philosophical sense. Aristotle says all sensations pass by ducts (πόροι) to the heart, 'the Acropolis of the body.'[9] Whether he recognised nerves is disputed, and he has no idea of a central nervous system. He may have meant nerves by πόροι, thinking them hollow, but this name also means sensory ducts, and νεῦρα means 'sinews', not 'nerves'.[10]

[1] Ogle, XI (*k*), 111. [2] XI (i), iv–v, 440–5.
[3] X, ii, 419*b*; Hammond, X (*k*), xlii.
[4] XI (iii), iii, 456–8; ζ', i, 2, 816*b*; A. E. Taylor, (1), 575.
[5] *De aëre locis et aquis*, *Œuvres*, ed. Littré, 1840, ii, 34.
[6] *Catarrhi deliramenta*, in *Ortus Medicinæ*, 1652, 345. 'Catarrh' is καтάρρоος, 'running down' (Plato).
[7] Ogle, XI (*k*), 1, 5, 11; Zeller, (1), II, ii³, 541, 544.
[8] *Opus Majus*, pt. 5, ch. 5; 1733, 263.
[9] VI, ii, 10, 656*b*; iii, 7, 670*a*; VII, ix, 702*b*; IX, ii, 6, 743*a*; v, 2, 781*a*; Lewes, 179; Ogle, XI (*k*), 169, 173, 176; Peck, IX (*a*), 563.
[10] Archer-Hind, 240, 275, 311; Lewes, 158, 167–179; Ogle, VI (*c*), 176, 196; Zeller, (1), II, ii³, 519.

There are seven flavours: sweet (including fatty or oily), bitter, salty, harsh (δριμύ), pungent, astringent, and acid. Flavour (χυμός) is produced in a moist substance by a dry, or is the 'sapid moist', the dry having the capacity of converting a potential into an actual taste.[1] It is a property or quality of the liquid, viz. 'flavoured'. A solid to be flavoured must first dissolve in the saliva; liquids can act directly.[2]

Odour is the 'sapid dry (τό ἔγχυμον ξηρόν)', produced by the dry both in air and water, and since the diaphanous is common to both, smell is exercised also in water or a moist medium by fish and testacea.[3]

The function of respiration[4] is to cool the blood in the lungs by air.[5] Aristotle criticises Plato's theory of abhorrence of a vacuum (see p. 64), which he calls a 'circular push (περίωσις, *circularis pulsio*)'. It assumed that the warm air from the mouth pushes forward the surrounding air and drives it inward through the pores of the flesh, 'because a vacuum is impossible (διὰ τὸ μηδὲν εἶναι κενὸν).' Aristotle compared the motion of the lungs with that of a brazier's bellows (τὰς φύσας ἐν τοῖς χαλκείοις).[6] He deviated from earlier views in supposing that the expansion and subsidence of the thorax, and the expansion and subsidence of the lungs, are the cause of the motion of the air.[7] Galen established that the movements of the thorax are due to muscular action, particularly of the diaphragm.[8] That fluid when drunk enters the windpipe (Plato's idea, see p. 63), Aristotle says, is a 'silly statement', since there is no connection with the oesophagus.[9]

A fire is put out by its own excess and respiration saves the heat of the heart. Air is cold relative to fire, its primary quality being moistness;[10] it is less hot than the heart and is so able to cool it. Respiration tempers the vital heat of the heart and prevents the blood from getting too hot and boiling over. In the heart the soul is, as it were, set on fire (ἐμπεπυρευμένης).[11] These views were taken over unchanged by Harvey (see Vol. II, p. 440). Aristotle may have borrowed them from the Hippokratic περὶ διαίτης (see p. 30).[12] Inspired air does not maintain animal heat, since the product of combustion would have to escape through the same passage, and nutrition and excretion never occur through the same channel.[13]

Animals are suffocated in a small volume of air because when it is breathed repeatedly it becomes too hot by contact with the blood in the lungs.[14] The air inside the breathing passage differs from the outer air in lightness (λεπτότητι).[15] If fish breathe they should expire air at the same moment, but an animal put into water emits bubbles of air, whilst a fish does not, hence fish have no air in their bodies. They are cooled by the water in the gills, but in nobler animals

[1] XI (i), iv, 442*a*; Ross, XI (*c*), 206.
[2] X, ii, 10, 422*a*.
[3] XI (i), v, 442*b*–443*a*; X, ii, 9, 421*a*–*b*; Hicks, X (*b*), 390; A. E. Taylor, (1), 475.
[4] XI (viii), iv, 472*a* f.; Lewes, 174; Ogle, VI (*c*), 17–48.
[5] VI, iii, 6, 669.
[6] XI (viii), vii, 474*a*.
[7] Boyle, *New Experiments Physico-mechanical*, 1660; *Works*, 1744, i, 65, mentions this.
[8] Ogle, XI (*k*), 49–50.
[9] VI, iii, 664*b*; Ogle, VI (*c*), 192.
[10] IV, ii, 3, 331*a*.
[11] XI (vii), iv, 469*b*; XI (viii), viii, 474*b*; xv, 478*a* (τοῦ ψυχικοῦ πυρός).
[12] Ross, XI (*c*), 56.
[13] Gomperz, (2), iv, 158.
[14] XI (viii), xvi, 478*b*.
[15] θ′, v, 483*b*.

the more efficient lungs are provided, the blood-vessels running alongside the bronchial tubes (σύριγγες).[1] Fish breathe *water* through the gills and in a small amount of water they are suffocated like an animal in a small amount of air.[2] Aristotle's view of respiration was a retrograde step from the Hippokratic theory that air maintains the heat of the body as it does a fire in a brazier, an opinion revived by Alexandrian physicians (see p. 167). Demokritos thought respiration replenished the soul with subtle atoms, and the Pneumatic School and Galen (see p. 192) often meant by *pneuma* something very like oxygen.[3]

Biochemistry

Parts of a living body are: (i) homogeneous (ὁμοιομερῆ) such as flesh, and non-homogeneous (ἀνομοιομερῆ), such as hands; (ii) things contrary to nature, such as a tumour; (iii) residue (περίττωμα); (iv) colliquescence (σύντηγμα, σύντηξις), an unnatural residue formed by decomposition; and (v) nourishment (τροφή).[4] The division into ὁμοιομερῆ and ἀνομοιομερῆ goes back to Anaxagoras (see p. 23), as Aristotle says.[5] In division of parts of vegetables[6] wood and bark are reckoned among ἀνομοιομερῆ, with root and leaf, so that histological analysis is carried further in botany than in zoology. Theophrastos[7] explained that sap, juice, fibre, bark, pith, wood, vessel, and flesh are 'elements' as far as biology goes. The *De Plantis* (spurious) attempts to classify the proximate constituents of plants; some contain resin, gum, myrrh, frankincense and gum arabic; trees have fibres, veins (φλέβες), flesh, wood, bark and pith (μυελός), which correspond with parts of animals.[8]

Aristotle[9] classified similar parts (ὁμοιομερῆ) or proximate constituents of animal bodies. The moist and fluid parts are blood, serum (ἰχώρ), lard (πιμελή), suet (στέαρ), marrow, semen, bile, milk, and flesh (σάρξ); hard and solid parts are bone, fish-spine (ἄκανθα), sinew (νεῦρον), blood-vessel (φλέψ), bladder, and cartilage (χόνδρος). Bone, fish-spine, and cartilage (a mixture of hard and earthy bone and soft marrow, which exist separate in bones) are distinguished. 'The essential being of flesh or bone is number only in this way: three parts of fire and two of earth,' i.e. 'the relative amounts in the mixture',[10] but[11] it is also said that fire and earth are present potentially (δυνάμει). Egg-shell can be dissolved in a liquid [vinegar] (τήκεται . . . τοῖς ὑγροῖς); bones have been 'baked' in formation like pottery.[12]

Blood is thicker and warmer in the lower part of the body. Fat and suet are made from blood not devoted to forming flesh. Marrow is also formed from blood, not as Plato thought from sperm (see p. 63). Blood is contained only in

[1] XI (viii), iii, 471*b*.

[2] V, viii, 2, 589*a*–*b*. Galen knew that water contains dissolved air, which fish use for respiratory purposes: Ogle, XI (*k*), 17.

[3] Allbutt, 152, 188, 224 f., 235 f., 250 f., 259.

[4] IX, i, 18, 724*b*.

[5] V, i, 1, 486*a*.

[6] III, iv, 10, 388*a*.

[7] *Hist. plant.*, I, ii, 1.

[8] ζ', i, 3, 818*a*.

[9] V, i, 1, 487*a*; iii, 2, 15–16 (fat, suet, bladder, membrane), 20, 517*b*–518*a*, 519*b*–520*a*, 521*b*–522*a*; VI, ii, 2–9, 647*b*–655*b*; Lewes, 298 f.; Ogle, VI (*c*), 22 f., 156, 163 (John Hunter had oil, lard, tallow, and spermaceti, in increasing order of hardness); M. Schmidt, *A. Med.*, 1957, xli, 317.

[10] XII, *N* (xiv), 5, 1092*b*.

[11] II, iii, 3, 302*a*.

[12] IX, ii, 6, 743*a*; for teeth, 744*b*–745*b*.

the heart and blood-vessels, and all motions of sensation, including pleasure and pain, begin and end in the heart.[1] Aristotle did not suppose that the arteries contain air and not blood. He noted the darker colour of venous blood.[2] Speaking of 'the great vessel (τῆς μεγάλης)' and the aorta (τῆς ἀορτῆς) of the blood vessels (τῶν φλεβῶν), he says the blood goes first into these when it leaves the heart.[3]

Very fibrous blood congeals quickest. But, as when earthy matter is taken out of mud the water remaining does not congeal, so with blood, for the fibres are earth. If they are not taken out it congeals, but while in the body it is fluid because of the heat there. Serum (ἰχώρ) is the watery part of blood.[4] The coagulum varies in consistency with different animals; the blood of the deer, roe, antelope and some other animals, owing to deficiency of fibre, does not coagulate to the extent of that of other animals, and in some diseased conditions the blood does not coagulate.[5]

Brain is not, as some think, the same as marrow, since brain is cold whilst marrow is greasy and hot. Brain contains earth, since it becomes hard when it is boiled.[6] A man's brain is larger than a woman's because the region of his heart and lungs is hotter and the blood needs more cooling.[7] The flesh of cephalopods is intermediate between flesh and sinew, since it is soft but elastic, and the bodies of insects are intermediate between bone and flesh.[8] Aristotle's[9] 'fish-spine' is found both in fish and serpents.

Milk contains much earth and is concocted blood.[10] The embryo gets its principle of generation from the white of egg and its nourishment from the yolk.[11] Rennet (πυτία) and the juice (ὀπος) of the wild fig-tree cause the 'setting (ἀποκρίσις)' of milk by the action of *pneuma*.[12] Rennet is found in all animals with a multiple stomach; the hare, with a single stomach, has rennet because it feeds on plants with a fig-like juice, and this juice can coagulate milk in the stomachs of sucklings. Animals have rennet because their milk is so thick.[13] The cheesy material (τυρόν) in milk (i.e. casein) was recognised, and it is correctly said that the milk of ruminants contains more 'cheese' than that of other animals.[14]

[1] VI, iii, 4, 666*a*.
[2] V, iii, 19, 520*b*: blood of inferior quality, either *naturally* or from disease, is darker.
[3] VI, iii, 5, 667*b*; Ogle, VI (*c*), 201, says the mistake that arteries contain air came from taking φλέψ as 'vein' instead of 'blood vessel', and ἀρτήρια as 'artery' instead of 'trachea'. In ψ-Aristotle θ', ii, 481*b*, the 'arteries' contain air (πνεῦμα).
[4] V, iii, 6, 515*b*–516*a*; 19, 520*b*; VI, ii, 4, 651*a*. Lewes, 284, thought to be *αἱ ἶνες* in Plato and Aristotle (V, iii, 2, 511*b*; VI, ii, 4, 650*b*) meant 'fibres' as such in the blood, not 'fibrin' in solution, but Ogle, VI (*c*), 160, thought the text suggests that Aristotle held that the fibrin is in solution, so anticipating Malpighi (*De polypo cordis*, *Opera omnia*, London, 1686, 125) and Borelli (*De motu animalium*, Rome, 1681, ii, 265–6, prop. cxxxii): see Vol. II. Aristotle's information on blood is, on the whole, very good.
[5] V, iii, 6, 515*b*–516*a*, 19, 520*b*; III, iv, 7, 384*a*; A. E. Taylor, (1), 591.
[6] VI, ii, 7, 653*a*. Brain and marrow are actually different in chemical composition.
[7] VI, ii, 7, 653*a*; Ogle, VI (*c*), 167, said the temperature of women is slightly higher than that of men.
[8] VI, ii, 8, 654*a*; a recognition of chitin.
[9] VI, ii, 9, 655*a*.
[10] IX, ii, 2, 735*b*; iv, 8, 776*b*.
[11] IX, iii, 1, 751*b*: both white and yolk are nourishment.
[12] V, iii, 21, 522*b*; VI, iii, 15, 676*a*; IX, i, 20, 729*a*; ii, 3, 4, 737*a*, 739*b*; iv, 4, 772*a*: the action is due to an enzyme.
[13] VI, iii, 15, 676*a*.
[14] V, iii, 20, 522*b*.

Gelatinisation is confused with coagulation (πῆξις) and no distinction is made between fibrin in blood and gelatin in broth,[1] although Aristotle speaks of skin, blood-vessel, membrane, and sinew as containing a 'glutinous (τό γλίσχρον)' which may correspond with gelatin.[2] All skin has a 'glutinous' on the surface, like the film on boiled liquids (milk ?) which does not evaporate.[3] Glue is made from ox-skin and also from fish (isinglass).[4]

Digestion is a 'cooking (πέψις, ἕψησις)' of food by heat.[5] The (otherwise unknown) physician Disarios (5 cent. A.D. ?) explained[6] that in digestion the third 'virtue' is transformation (ἀλλοιωτική) which changes one sort of food into another, the indigestible residue (*faex*) being expelled by the intestines. Aristotle said there are four digestions. The first occurs in the stomach and lymphatic vessels and the last in the heart, which concocts the blood by its heat,[7] and the blood then passes from the heart (he knew nothing of its return).[8] The sweet part of food (including fat) is the most nutritious and mainly causes growth; this explains the longevity of bees.[9]

The treatise on longevity[10] broached the famous theory of 'radical moisture (φύσει ὑγρὸν καὶ θερμὸν; *humidum radicale*)' which was ridiculed by Van Helmont.[11] An animal is naturally moist and warm, life depending on these conditions, and in old age it dries up. Hence its moisture must not easily dry up, and fat bodies are preserved from decay because they are of air, and air acts like fire in relation to other things (ὁ δ' ἀὴρ πρὸς τἆλλα πῦρ) and does not putrefy. The moisture must be in sufficient quantity: large animals and plants live longer. But it must also be warm, so that it does not congeal or dry up easily, hence man lives longer than most large animals. Animals with less moisture live long if the quality of the moisture makes up for its lack of quantity, and there are some whose fat and warmth make it difficult for them to become dry and cold, and so die. There must not be a large production of waste products, which produce death by nature or by disease. 'When plants and animals take no nourishment they perish; they then consume their own substance (συντήκει γὰρ αὐτὰ ἑαυτά). For as a flame destroys a smaller flame by consuming its food, so the natural heat which is the primary digester destroys the substance in which it is. Plants, less watery and less easily congealed, live longer than animals; they are fat and viscid, and although dry and earthy, do not readily lose their moisture.'

What Aristotle calls 'residue (περίττωμα)' is left over in the organism after digestion of nutriment, the useful part having been turned into blood. It includes marrow, semen, catamenia, and milk, sometimes lard and suet; hair, nails, and claws are residues which have made their way to the surface; faeces, as the dregs of solid nutriment, and urine, of liquid nutriment, and bile, are

[1] VI, ii, 5, 651*a*; Ogle, VI (*c*), 163.
[2] IX, ii, 3, 737*a*.
[3] V, iii, 12, 517*b*; IX, ii, 6, 743*b*.
[4] V, iii, 11, 517*a*.
[5] VI, ii, 3, 6, 650*a*, 652*a*; iii, 14, 674*a*; Baeumker, 119; A. E. Taylor, (1), 568.
[6] Macrobius, *Saturnalia*, vii, 4.
[7] VI, iii, 4, 666*a*; XI, (vii), iv, 469*b*.
[8] Rolfes, (2), 247.
[9] XI (vi), v, 467*a*; actually only the queens are long-lived.
[10] XI (vi), v, 464*b*–467*b*.
[11] *Ortus Medicinæ*, 1652, 572.

also residues.[1] Blood is converted into milk in the mammary organs,[2] into semen in the seminal organs,[3] and into fat in all parts of the body.[4] Bile (χολή) is an excretion serving no useful purpose,[5] and black bile is cold in nature.[6] Birds and serpents, having no bladder, have an excrement white on the surface, as urine deposits an earthy salt in vessels.[7] The stone which deposits in the bladder is like that which encrusts vessels in which urine has stood.[8]

A colliquescence (*σύντηγμα, σύντηξις*, 'melting down'), is that which is produced as an abscession (*ἀποκρισις*) from material which supplies growth, as a result of decomposition contrary to nature (*ὑπὸ τῆς παρὰ φύσιν ἀναλύσεως*).[9] It has no proper place in nature and runs about in the body (*ἀλλὰ ῥεῖ ὅπου ἂν εὐοδήσῃ τοῦ σώματος*).[10] In the formation of flesh or its analogues, the nutritive fluid filters through the veins and canals to each part like water oozing through unglazed earthen vessels (*ὠμοῖς κεραμίοις*, a vague anticipation of osmosis) and coagulates on cooling. The formation of different parts (nails, hair, bones, sinews, eyes, teeth, skin (which is dried flesh, as in Plato), etc.) is explained.[11]

Aristotle believed in spontaneous generation (*γένεσις αὐτοματός*, *generatio aequivoca*). Testacea are generated spontaneously out of a certain earthy and fluid coagulation (*ἔκ τινος συστάσεως γεοειδοῦς καὶ ὑγρας*).[12] Plants and animals arise in putrefying substances containing water, but not by putrefaction (*σῆψις*), the putrid substance being only a secretion from that producing the living things by coction. In water there is *pneuma* and in a sense all things have life (*ψυχή*). By means of the heat in a small space, the fluid substance containing corporeal matter is formed into a kind of foam vesicle (*ἐμπεριλαμβάνεται δὲ καὶ γίνεται θερμαινομένων τῶν σωματικῶν ὑγρῶν οἷον ἀφρώδης πομφόλυξ*).[13]

Aristotle supposed that the menstrual fluid (he did not know of the microscopic ovum) supplies the primary matter (*πρώτη ὕλη*), whilst the sperm (*γονή*), which alone contains *pneuma*, acts upon this by giving it a form, impulse, or principle of movement.[14] The sperm is a 'residue' of blood, not (as Hippokrates said) from the whole body.[15] Sperm and menstrual fluid are only partly concocted, and only a small part of each is used in forming the embryo, the rest being useless fluid. The menstrual fluid contains the vegetative soul, the sperm the sentient and (in man) the rational soul (see p. 121), the latter being alone divine and coming from outside.[16] The doctrine of epigenesis (so named by Harvey) was first clearly stated by Aristotle.[17]

[1] V, iii, 2, 511*b*; VI, ii, 2, 647*b*; 3, 650*a*; iii, 7, 8, 670*b*–671*a*; 14, 675*b*; iv, 1, 2, 676*a*, 677*a*; IX, ii, 4, 6, 738*a*, 744*b*–745*b* (details of formation of bone, teeth, nails, hair, etc., from 'residues'); v, 3, 782*a* (hair in detail); Ogle, VI (*c*), 159; Peck, VI (*e*), 32; IX (*a*), lxiii–lxvi.
[2] IX, iv, 8, 776*b*. [3] IX, i, 18, 725*b*. [4] VI, ii, 6, 652*a*. [5] VI, iv, 2, 677*a*.
[6] XI (iii), iii, 457*b*. [7] VI, iv, 1, 676*a*; 5, 679*a*: uric acid.
[8] δ', x, 43, 895*b*. [9] IX, i, 18, 724*b*.
[10] IX, i, 18, 725*b*; Peck, IX (*a*), lxvi. Colliquescence is a common Hippokratic term.
[11] IX, ii, 6, 743*a*–745*b*. [12] IX, i, 23, 731*b*. [13] IX, iii, 11, 762*a*.
[14] IX, i, 18–23, 726*a*–731*b*; Zeller, (1), II, ii³, 525–6.
[15] VI, iv, 10, 689*a*; IX, ii, 2, 735*a*; Ogle, VI (*c*), 239.
[16] IX, ii, 2, 736*a*–*b*, 737*a*–739*a*; X, ii, 2, 413*b*; Peck, IX (*a*), xii–xiv, 30; Waszink, 342 f. (full discussion). This view was adopted by the Pneumatic School of physicians.
[17] IX, ii, 1, 733*b*; Lewes, 351 f.; Peck, IX (*a*), x.

The Soul

The word ψυχή represents both 'soul (*anima*)' and 'life (*animus*)'; 'vital principle' includes much that 'soul' omits but lacks something which 'soul' includes, and 'mind' lacks meaning in the opposite sense; 'soul' is perhaps the best translation.[1] The idea of a 'principle of life' rising from warm blood as a fine smoke is Oriental and older than the Greek ψυχή.[2] For Aristotle, the soul is the capability of a body to produce changes in itself, or is the first entelechy (reality) of an organic physical body (ἡ ψυχή ἐστιν εντελέχεια ἡ πρώτη σώματος φυσικοῦ δυνάμει ζωὴν ἔχοντος).[3] It is a 'function' of the organism, an animal being a union of a body and a soul. In a person asleep the soul is the 'first' entelechy, in a person awake it is the 'second' entelechy.[4]

Aristotle[5] recognised the three souls (vegetative, animal, and intellectual) distinguished by Plato (see p. 62), but also divided the 'faculties (δυνάμεις)' of the soul into: (i) nutritive or generative (θρεπτικόν) in all plants, (ii) sentient (αἰσθητικόν) in all animals, (iii) appetitive (ὀρεκτικόν) in some animals, (iv) locomotive (κινητικόν) in some animals, and (v) rational (διανοητικόν) in man only, who also has all the other four, and hence is a microcosm.[6] Aristotle's number of manifestations or faculties of the soul varies; sometimes there are three, sometimes four or five, or even indefinitely many (ἄπειρα).[7] He thought a greater heat in an animal corresponds with a nobler soul.[8] The bodily heat is in the πνεῦμα mingled with the blood, and is different from the innate spirit (πνεῦμα σύμφυτον).[9] The human soul is that principle by which, in an ultimate sense, we live, feel, and think, a sort of idea and form, not matter and substrate (εἴη καὶ εἶδος, ἀλλ' οὐχ ὕλη καὶ τὸ ὑποκείμενον).[10] It is a substance (οὐσία) in a sense, the form of a natural body endowed with the faculty of life (εἶναι ὡς εἶδος σώματος φυσικοῦ δυνάμει ζωὴν ἔχοντος).[11] It is sometimes compared with heat (θερμόν), or breath (πνεῦμα), or ether (αἰθήρ, the element of the stars, of a nobler nature than the four elements).[12]

A living being is not a compound of body and soul, but the soul is the moving force of the body, its 'form', and the body is the instrument of the soul; they are inseparable. Each body has its particular soul and there is no transmigration of souls.[13] The incapacities of animals (age, decay, etc.) are unnatural, 'due, it seems, to the fact that the whole animal complex is made up of materials which differ in respect of their proper places and no single part occupies its own place.'[14] The true cause of old age and death is the

[1] Lewes, 222 f.; Ogle, VI (*c*), 145; Peck, IX (*a*), lvii.
[2] Gomperz, (2), i, 249: Rohde, ii, 145 f., 258.
[3] X, ii, 1, 412*a*–*b*; Gomperz, (2), iv, 159; Lewes, 231; Zeller, (1), II, ii³, 481.
[4] IX, ii, 1, 735*a*; X, ii, 1, 412*a*; Hammond, X (*h*), 44.
[5] V, viii, 1, 558*a*; X, ii, 2–3, 413*a*–415*a*; Kaufmann, 54; Peck, IX (*a*), lviii; Zeller, II, ii³, 479.
[6] Hammond, X (*h*), xx f., xxvi f.; Hett, X (*d*), 4, 64 f.; Hicks, X (*b*), xlv, 299; and Peck, IX (*a*), xlix f.; quoting X, i, 5, 410*b*–411*a*–*b*; iii, 1–7, 425*a*–431*a*.
[7] X, iii, 9, 432*a*.
[8] XI (viii), xiii, 477*a*.
[9] Windelband, (1), 150; Zeller, (1), II, ii³, 483.
[10] X, ii, 2, 414*a*.
[11] X, ii, 1, 412*a*; X (*h*), 42 f.; Zeller, (1), II, ii³, 486.
[12] IX, ii, 3, 736*b*; Cudworth, i, 98; Zeller, (1), II, ii³, 483.
[13] Zeller, (1), II, ii³, 486–7.
[14] II, ii, 6, 288*b*; Prantl, (2) (*a*), ii, 300.

gradual loss of the innate heat, not completely replenished and finally becoming like 'a flickering flame, which the slightest puff will put out'.[1]

The intermediary between the body and the soul (ψυχή) is the innate spirit or connate pneuma (πνεῦμα σύμφυτον), situated in the heart (or what in some animals corresponds with the heart), and a motive power.[2]

It is uncertain if Aristotle regarded mind (νοῦς), or the faculty of thinking, as immortal. The crucial passage[3] is: 'Respecting mind and the theoretic faculty, nothing as yet is evident, but it seems to be another kind of soul (ἔοικε ψυχῆς γένος), and it alone is capable of separation, as the everlasting from the perishable (μόνον ἐνδέχεται χωρίζεσθαι, καθάπερ τὸ ἀΐδιον τοῦ φθαρτοῦ).' Galen's three souls, in the liver, the heart, and the head, are all mortal.[4] Only the intellect (νοῦς) enters from without. It alone is godlike. Its actuality has nothing in common with corporeal activity (οὐθὲν γὰρ αὐτοῦ τῇ ἐνεργείᾳ κοινωνεῖ σωματικὴ ἐνέργεια).[5]

In all sperm there is the so-called heat, which effects generation. This is not fire or anything like it (οὐ πῦρ οὐδὲ τοιαύτη) but a breath (πνεῦμα) contained within the sperm (σπέρμα) or foam-like body, the natural substance which is in the pneuma (ἐν τῷ σπέρματι καὶ ἐν τῷ ἀφρώδει πνεῦμα καὶ ἡ ἐν τῷ πνεύματι φύσις), and is analogous to the ether. Hence fire does not generate an animal, as the heat of the sun and the heat of animals, operating through the sperm, do.[6] The sperm contains much hot pneuma (θερμότητος πνεῦμα) owing to the internal heat of the animal; it is a foam (ἀφρός) of pneuma and water, pneuma being warm air (πνεῦμα ἐστι θερμὸς ἀήρ).[7]

Aristotle distinguished innate pneuma (πνεῦμα σύμφυτον) and innate heat (συμφύτον θερμόν, ἔμψυχος θερμότης), or natural heat (θερμότης φυσική), or vital heat (θερμότης ζωτική).[8] The central organ of the innate heat, producing digestion, is the heart.[9] Plants and cold-blooded animals also have natural heat.[10] Menestor is said[11] to have found evidence of heat in plants because some water-plants do not freeze in winter, and snow melts on the leaves of some trees. The meaning of πνεῦμα in Aristotle has been much discussed.[12]

The disciples of Aristotle continued the Peripatetic School; important members were Theophrastos and Straton, both of whom were scientists in the true sense. The later members were mostly commentators, such as Alexander of Aphrodisias (*c.* A.D. 200), Philoponos, Simplikios, and David of Armenia 6 cent.).[13]

[1] XI (viii), xvii, 479*a*. [2] VII, 10, 703*a*; Lewes, 178–9. [3] X, ii, 2, 413*b*, 24.
[4] Lewes, 233. [5] IX, ii, 3, 736*b*. [6] IX, ii, 3, 737*a*.
[7] IX, ii, 3, 735*b*–736*a*.
[8] XI (iii), iii, 457*b*–458*a*; XI (viii), vi, 473*a*; XI (*c*), 40–3.
[9] X, ii, 4, 416*b*; XI (vii), iii, 469*a*; Zeller, (1), II, ii³, 517.
[10] XI (vii), vi, 469*b*, 470*b*.
[11] Theophrastos, *De causis plant.*, I, xxi, 6.
[12] Gilbert, 305 f., 323, 568, 629; Hofsten, *Lychnos*, 1937, ii, 341; Jaeger, *Hermes*, 1913, xlviii, 29–74; Lewes, 356; Ogle, VI (*c*), 183 (innate as distinct from spirit or breath coming from outside, ἔμφυτον πνεῦμα as contrasted with πνεῦμα ἐπείσακτον); Peck, IX (*a*), 576–93; *id.*, in Singer, (4), i, 111.
[13] Brink, PW, Suppl. vii, 899–948.

CHAPTER V

THEOPHRASTOS AND STRATON

THEOPHRASTOS

Theophrastos (Θεόφραστος) (372/69–288/5 B.C.), born at Eresos in Lesbos, was a pupil in Athens first of Plato and later of Aristotle, whom he succeeded as head of the Lyceum.[1] He conducted the school with great success and cultivated all branches of knowledge. Most of the information about him comes from Diogenes Laertios.[2] Although most of his works revised and extended treatises by Aristotle, Theophrastos was more original than was formerly supposed, and deviated in many ways from Aristotle. His style (like Aristotle's) is elliptical and difficult.

Works

Apart from a large work on *Characters* (χαρακτῆρες) and some small treatises mentioned later (see p. 134), the writings of Theophrastos include:

A. *Enquiry into Plants* (περὶ φυτῶ ἱστορίας, *Historia plantarum*) in 9 books.
B. *Causes of Plants* (περὶ φυτῶν αἰτιῶν, *De causis plantarum*) in 6 books.[3]
C. *On Odours* (περὶ ὀσμῶν, *De odoribus*).
D. *On Colours* (περὶ χρωμάτων, *De coloribus*).[4]
E. *On Fire* (περὶ πυρὸς, *De igne*).
F. *On Waters* (περὶ ὑδάτων).
G. *On Stones* (περὶ λίθων, *De lapidibus*).
H. *Fragmenta.*

The botanical works were first published in Latin translations made by Theodore of Gaza (*c.* 1400–78).[5] Greek texts of several works were first printed in 1497 with works of Aristotle.[6] Some smaller works (C, E, G) were translated into Latin by Adrian Turnebus (1512–65), professor of Greek in Paris.[7] Some of the collected works were edited by Schneider and Wimmer:

[1] Brandis, (1), 1860, III, i, 250–374; *id.* in DBM, iii, 1087–91; Brunet and Mieli, 292; Deussen, (1), II, i, 385; Farrington, 1949, ii, 17–27; L.G. in NBG, 1866, xlv, 103; Zeller, (1), II, ii³, 806–69; E. Howald, *Hermes*, 1920, lv, 204; Jaeger, (1), 1938, 114; Regenbogen, PW, 1940, Suppl. vii, 1354–1562; Senn, *Philologus*, 1930, lxxxv, 113.
[2] V, ii, ed. Cobet, Paris, 1850, 119–24 (long list of works); BG, (1) (*b*), iii, 408–57; Usener, *Theophrastea*, Leipzig, 1858; *id.*, *Kleine Schriften*, Leipzig and Berlin, 1912, i, 51–87.
[3] Brandis, DBM, iii, 1087, gives αἴτια φυτικά; Zeller, (1), II, ii³, 838 αἰτιῶν φυτικων.
[4] This work is the same as that attributed to Aristotle. It is printed in Schneider's ed. of the works of Theophrastos (K) and may be by him: E. H. F. Meyer, i, 195.
[5] E. H. F. Meyer, iv, 215.
[6] Klebs, 46, 317; reprinted (ed. Camotius), 8°, Venice, 1552, in vol. vi; f°, Basel (Oporinus), 1541 (pp. 291).
[7] Jöcher, iv, 1358.

K. *Theophrasti Eresii quae supersunt Opera*, ed. D. H. F. Link and Johann Gottlob Schneider, 5 vols., 8°, Leipzig, i–iv 1818; v 1821: i Greek text; ii and iii Latin trs. by Turnebus and Gaza with emendations; iv–v notes and corrections, index.

L. *Theophrasti Eresii Opera, quæ supersunt, . . . Latinus interpretatus est, indices rerum et verborum absolutissimos adjecit Fredericus Wimmer*, 8°, Paris (Didot), 1866. This is the latest complet ed. available, and the one quoted here, but it is out of date.[1]

The two botanical works were perhaps composed about 308–5 B.C.[2] Some fragments of a work on *Metaphysics*[3] remain.

Theophrastos assumed that, since all natural bodies are composite, they must have principles (ἀρχαι), particularly motion (κίνησις), which is the basis of all changes. He denied the subsistence of space, regarding it as the mere arrangement (τάξις) and position (θέσις) of bodies. He did not think activity expended itself in motion, recognised no activity without motion, and so referred all activities of the soul to motion, the existence of a spirit independent of organic activity being doubtful.[4] He seems to have understood by ὕλη a definite substance, not merely a formless substrate.[5] He identified pneuma (πνεῦμα) with fire (τὸ πῦρ οἷον πνευματός τις φύσις).[6] He knew a fairly extensive astrological system.[7]

On Plants

There are several editions of the botanical works of Theophrastos:

M. *Theophrasti Eresii De Historia Plantarvm Libri Decem, Græcè & Latinè . . . Ioannes Bodævs à Stapel . . . Accesservnt Ivlii Cæsaris Scaligeri, in eosdem Libros Animadversiones, Cum Indice locupletissimo*, f°, Amsterdam, 1644, 1187 pp. text and index, commentary 'botanically monumental', Hort, N. *Theophrasti Eresii de Historia Plantarum libri decem Græce. Cum Syllabo Generum et Specierum, Glossario, et Notis, Curante Joh. Stackhouse*, 2 vols., Oxford, 1813–14 (portr.; botanically good)[8].

N. Theophrastus. *Enquiry into Plants, and Minor Works on Odours and Weather Signs*, ed. and tr. Sir A. Hort, Loeb, 2 vols., 1916 (portr. of Th., intr., index and key).

O. *Theophrast's Naturgeschichte der Gewächse*, tr. Sprengel, 2 vols., Altona, 1822 (not very good, but includes tr. of B, not in N).

The Enquiry into Plants (A) describes about 550 different plants divided into trees, herbs and shrubs,[9] then the 'parts' of plants, cereals, juices of plants, and medicinal properties of herbs. Theophrastos followed Aristotle in believing in spontaneous generation.[10] A few items may be mentioned.

[1] W. Jaeger, (1), 114.
[2] Jaeger, (1), 114, 119 (290–87 B.C.); Regenbogen, 1415 (315–14 or 300–295 B.C.).
[3] L, 410; ed. W. D. Ross and F. H. Fobes, Oxford, 1929; Jaeger, *Gnomon*, 1932, viii, 289.
[4] H, xvii–xxvi, liii*b*; L, 418–20, 427.
[5] G, §§ 4–6; Baeumker, 295.
[6] E, iv, 30.
[7] Riess, PW, ii, 1811 f.
[8] Bk. ix of A may be spurious and later. Bk. x exists only in a fragment on roots (περὶ δὲ τῶν ῥιζῶ) Fabricius, (1) (*b*) iii, 413; Regenbogen, 1450; C. Singer, *J. Hellen. Stud.*, 1927, xlvii, 1–52; *Isis*, 1927, x, 519.
[9] Brandis, (1), III, i, 302; H. Bretzl, *Botanische Forschung des Alexanderzuges*, Leipzig, 1903 (Th.'s information from old sources, e.g., ῥιζοτομικόν of Diokles of Karystos (4 cent. B.C. ?) and Eastern material from Alexander's expeditions); A. Buckley, *A Short History of Natural Science*, 1883, 17; Hoefer, (3), 54; O. Kirchner, *Jahrb. f. Philol.*, 1873–5, Suppl. vii, 449–539; Lenz, (2); A. Schmidt, 64; Zeller, (1), II, ii[3], 839.
[10] Brandis, 307; Zeller, 842.

Air, climate, situation, soil, and manure influence the growth of plants[1] just as animals change, e.g. the hawk into the hoopoe, and the water snake into a viper if the marshes dry up.[2] India, and also the island of Tylos (Bahrain in the Persian Gulf), produce wool-bearing trees (τὰ δένδρα τὰ ἐριοφόρα) which in place of fruit have capsules which when ripe unfold and put forth the wool (i.e. cotton) from which fabrics are woven.[3] Papyrus (ὁ πάπυρος) grows in the shallow waters of the Nile; the stalks, of which paper is made, are triangular. The roots are used for burning instead of wood, the stem is chewed both cooked and raw, and is used to make sails, ropes, mats, clothing and papyrus rolls. It also grows in a lake in Syria.[4] Honey (μέλι) is generated (i) from flowers and other sweet things, (ii) from dew thickened by the heat of the sun, and (iii) in reeds (ἐν τοῖς καλάμοις).[5] The second kind is manna of oaks and limes and the third the juice of the sugar cane. The Indian reed (κάλαμος Ἰνδικὸς)[6] is bamboo.

Plants yielding colours are alkanet (ἄγχουσα),[7] red root (ἐρυθέδανον),[8] carthamus (κνῆκος),[9] and *Rocella tinctoria* (litmus) (φῦκος, *phukos*), growing on rocks near the sea-shore in Crete and used to dye ribbons, wool, and clothing a beautiful purple (πορφύρας).[10]

There is a description of making charcoal (ἄνθραξ) from woods in kilns or meiler.[11] Fire-drills (πυρεῖα) are made, according to Menestor, from a stationary piece of ivy-wood, easily kindled, and a drill of bay-wood, not much worn by use.[12] The Persian nut (καρύα περσική),[13] sweet-flag (κάλαμος), ginger-grass (σχοῖνος), galbanum (χαλβάνη), nutmeg (or cinnamon) (κώμακον), car damom (καρδάμωμον), amomum (ἄμωμον), myrrh (σμύρνα), frankincense (λίβανος), balsam (ὀποβάλσαμον), cinnamon (κινάμωμον), spikenard (νάρδον), cassia (κασία), sage (ναῖρον), camel's thorn (ἀσπάλαθος), storax (στύραξ), *narte* (νάρτη), costus (κόστος), cassia (κασία), all-heal (πάναχος), saffron-crocus (κρόκος), galingale (κύπειρον), marjoram (αμάρκον), dill (ἄννητος), and lotus (λωτός), are all Oriental aromatics; iris (ἶρις) is a product of Illyria.[14] Balsam (of Mecca) (βάλσαμον), cultivated in the valleys of Syria, flows as 'tears (δάκρυ)' from incisions made with pieces of iron when there is scorching heat; it is adulterated, for it mixes freely with other things. The pure gum sells for twice its weight of silver.[15]

The acacia (ἄκανθα) grows in Egypt and has medicinal properties; gum (κόμμι) is produced from it by incision and also by natural exudation;[16] it thickens water, as does marsh-mallow.[17] Gums are obtained from firs,

[1] A, II, ii, 7 f., II, iii, 1 f.; II, vii, 4; IV, xi, 7 f.; B, III, iv, 3.

[2] A, II, iv, 4; for a description of fish living on land, H, clxxi, L, 455; ψ-Aristotle, *De Mirab.*, 72–3, 835*b*.

[3] A, IV, vii, 7–8; the first definite mention of Indian cotton is in Herodotos, iii, 106; vii, 65; Tylos would be on the route of transmission to Egypt; Schrader, (1), 61.

[4] A, IV, viii, 3, 4.

[5] H, cxc; L, 462; Lippmann, (5), 117.

[6] A, IV, xi, 13.

[7] A, VII, viii, 3; ix, 3; C, 31, 33.

[8] A, VI, i, 4; VII, ix, 3; IX, xiii, 6; perhaps madder ?; in Herodotos, iv, 189.

[9] A, I, xiii, 3; VI, i, 3; iv, 3, 6; ἀτρακτυλίς in VI, iv, 6; IX, i, 1.

[10] A, IV, vi, 5; N, i, 333; ii, 483.

[11] A, V, ix, 1–6.

[12] A, V, ix, 6.

[13] A, III, vi, 2; probably the walnut.

[14] A, IV, iv, 1 f., 14; IX, vii, 1–4; C, 25, 32.

[15] A, IX, vi, 1–4.

[16] A, IV, ii, 8; IX, i, 2 (an Indian tree).

[17] A, IX, xviii, 1; IV, ii, 309.

terebinth, pines, almonds, cherry, cedar, tragacanth (τραγάκανθα), and elm [i.e. the excretion *ulmin*]; gum resins such as frankincense, myrrh, mastic gum, galbanum, almond gum, silphium, scammony (σκαμμωνια), Syrian balsam, and resin, are obtained with or without incision.[1] The extraction of wood pitch (πίττα) in a meiler is described in detail.[2]

The ninth, perhaps spurious, book of A deals with medicinal uses of plants and drugs and contains much superstitious material, sometimes criticised as 'sheer fable (τῷ ὄντι μῦθος)';[3] tales of amulets and charms are 'foolish and incredible'[4] but love potions (φίλτρα) are described seriously.[5] A drug called 'the driver (τό ελατήριον)', made from the juice of the squirting cucumber, puts out a lamp if brought near it;[6] pumice dust put into a pot of boiling wine stops the boiling at once,[7] and hellebore sprinkled on a dead scorpion brings it to life.[8] Numerous poisons, some which kill at once and some after weeks or months, all of vegetable origin, are described, and antidotes are often given for them.[9]

Medicinal juice (ὀπός) is prepared from various roots and other parts of plants by the druggist, mostly in summer, whilst the root diggers (ῥιζοτόμοι) work in autumn. Only the juice of the poppy is taken from the head (ἀπο τῆς κεφαλῆς ὥσπερ τῆς μήκωνος). This is opium, but the juice of spurge (τιθύμαλλος) is also called μηκώνιον. The juice is collected in vessels, or absorbed by wool, or an extract is made with water.[10] The sweet Scythian root (γλυκεῖα ῥίζα ἡ Σκυθική), which cures cough and quenches thirst,[11] is probably liquorice. The effect of all drugs diminishes with use, and they act differently on different constitutions.[12]

On Odours

The treatise on odours[13] (C) says that odours are due to mixture; some simple substances (water, air and fire) have no smell; earth has a smell (or at least more than the other elements) because it is of a more composite character (τὰ ἁπλᾶ ἄοδμα). Unlike tastes, the varieties of good and bad smells have received no specific names. Anything putrefying has an evil odour (i, 1–3). Every thing has an odour peculiar to itself, often imperceptible to us but perceptible to animals (ii, 4).

Odours artificially produced are used especially in perfuming wine; two

[1] A, IX, i, 1–7; ii, 1–8; vii, 1–4.
[2] A, IX, iii, 1–4; N, ii, 229 f.; see Vol. II, fig. 15.
[3] The story in Herodotos, iii, 107, 111, of snakes in gathering cassia is so described; IX, v, 1; and the posturing of druggists and herbalists (φαρμαποπῶλαι καὶ ῥιζοτόμοι) in digging mandrake, etc.: A, IX, viii, 5 f.; B, VI, iv, 5.
[4] A, IX, xix, 2.
[5] A, IX, ix, 1, 3.
[6] A, IX, ix, 4; xiv, 2; xv, 6.
[7] A, IX, xvii, 3.
[8] A, IX, xviii, 2.
[9] A, IX, viii, 3; xi, 5 f. (*strychnos*); xiii, 4; xv, 2 (Ethiopian arrow poison); xvii, 4 f. (aconite, ἀκόνιτον, for which there is no antidote); xix, 1 f.; xvi, 8 (Thrasyas of Mantineia's painless poison); X, 1 f. (white and black hellebore); IV, ii, 9; IX, viii, 8; ix, 1; B, VI, iv, 5 (*Atropa belladonna* and *Mandragora officinalis*, μανδραγόρας).
[10] A, IX, viii, 1–4.
[11] A, IX, xiii, 2.
[12] A, IX, xvii, 1 f.
[13] *Theophrasti Libellus de Odoribus ab Adriano Turnebo Latinitate donatus, et scholiis atque annotationibus illustratus*, Apud Michaëlem Vascosanum, 2 pts., 4°, Paris, 1556 (BM 520. c. 19. (1.); K, i, 752–7 (text); ii, 397–411 (Latin tr.); iv, 640–80 (notes); L, 364–76 (paras. numb. 1–71 through chs. i–xiv); N, ii, 327 (paras. numbered in chapters); C i. 3. states that odour is due to exhalation (τὸ γὰρ τῆς ὀσμῆς ἐν ἀναπνοῇ).

kinds of things, liquid and solid, may be combined in three pairs. The commonest method, as in making perfumes and ointments, is to mix solid with liquid (iii, 7–8). Wine has a special property of assimilating odours. Sweet wine (οἶνος γλυκύς) is used in admixture (μῖξις) with other wines, since it has no smell (διὰ τὸ μηδὲν ἔχειν) (iii, 11).[1] Myrrh, of close texture, must be 'opened' by fire or steeping in wine to exhale its odour (iii, 44).

Oil is the vehicle of perfumes; almond oil, the most viscous, is most, sesame and olive oils least, receptive (iv, 14). Egyptian or Syrian *balanos* (ben oil) is most used, though oil of bitter almonds (ἐκ τῶν πικρῶν ἀμυγδάλων) from Kilicia is best for unguents (iv, 15). Heat is used, 'but in all cases in vessels (ἀγγείων) standing in water and not in contact with the fire, for the heating must be gentle, and there would be considerable waste in actual contact with the flames; further, the perfume would then smell of burning' (v, 22) — the water-bath.[2]

Salt is added in making rose perfume (v, 25); some perfumes are coloured, e.g. with alkanet (ἄγχουσα, which is soluble in oil) (vi, 31). Odorous materials are classified according to the pungency and heat they contain and their medicinal properties, and rules for mixing and storing perfumes (in lead or alabaster phials, which keep them cool and prevent the escape of volatiles) are given (vii–x, 32–42). An obscure passage (xiv, 71) has been supposed to mention the tinning of iron. The long section on odours and tastes in the *De causis plantarum*[3] has been mentioned under Aristotle.

On Fire

The treatise on fire (E)[4] says fire differs from other elements in requiring a substrate or nutriment, and produces and destroys itself without the action of other forces. There are three kinds: flame, burning coal, and light (1–6). There is no fire without moisture (ὑγρόν), flame is a battle between the elements fire and water in the food of fire (ὕλη) (10, 21). Water extinguishes fire unless it is in great quantity (27). Cold vinegar extinguishes fires not put out by water, e.g. burning pitch (25, 59). There are some remarks on the structure of flame 50–56). Wine when thrown on a fire, as in libations, produces a flame (ἐκλάμπει) (67). Thick stagnant air in mines is suffocating (24). Since breath

[1] A. Schmidt, 31, says this is the first Greek mention of perfumed wine, afterwards used in Rome; see Pliny, xiv, 19 (including absinthe and gin).

[2] N, ii, 347; the water-bath is mentioned in the Hippokratic writings (see p. 27); Cato, *De agri cultura*, c. 81 (prep. of a food Erneum: in irneam fictilem eam dimittito in aulam aheneam aquae calidae plenam, ita coquito ad ignem); Blümner, i, 353; S. Günther, in I. Müller, (1), 1888, V, i, 54; J. G. Schneider, (1), 1801, i, 240; ii, 134–5; all before Lippmann, in Diergart, (1), 1909, 143; *id.* (1), ii, 187 ('bisher ganz unbeachtet'); K. B. Hofmann, *A. Nat.*, 1911, iii, 307.

[3] B, VI, i–viii.

[4] *Theophrasti de Igne Lib. Adr. Turnebo interprete. Eivsdem in Evndem Adnotatiunculæ*, Paris 1553 (M.D.LIII) Apud Adr. Turnebum typographum regium. Ex Priuilegio Regis. (t.p., followed by 1 l. pref. pagin. as '17'); second t.p.: *ΘΕΟΦΡΑΣΤΟΥ ΠΕΡΙ ΠΥΡΟΣ. Theophrasti de Igne.* Paris, 1552 (M.D.LII) (*sic*). Apud Adr. Turnebum typographum regium; sm. 4°, 24 pp. Greek text, Latin tr. sep. pagin. 1–25, 1 l. notes; also 4°, Paris, 1567 (BM 514. e. 16. (2.)); *Theophrasti libelli duo: unus de igne, alter de odoribus, interprete Adriano Turnebo.* Ex officina Societatio Typographicae, 12°, Hardevici (Harderwijk), 1656 (Latin tr.); K, i, 705 f. (text); ii, 435 f. (Turnebus's Latin tr.); iv, 594 f. (notes); L, 350–64; Gilbert, 197 f.; Gomperz, (2), iv, 468; T. Robinson, *Chymia*, 1959, v, 51–63; J. G. Schneider, (1), i, 235; ii, 131 f. The numbers in brackets in the text are paragraph numbers.

nourishes breath, fire is of the nature of breath (τοῦτο μὲν οὖν οὐκ ἂν ἀλόγως δόξειε συνεργεῖν πνεύματι πνεῦμα, καὶ γὰρ τὸ πῦρ οἷον πνεύματός τις φύσις) (30).[1] A flame is extinguished by a strong wind (ἔτι τοῦ τε φλογώδους [MSS. φωτίζειν] καὶ ὑπὸ πνεύματος μεγέθους) (21).

Different kinds of fire are used in the arts, gentle fire for softening, melting, and dividing into small parts (διάλυσίς τις κατὰ μικρὸν), strong fire in smith's work (χαλκευτικῇ) (37). Ductile and fusible metals are liquefied and broken by cold, tin (καττίτερος) and lead (μόλιβδος) are as if melted (τακῆναι) by intense cold in winter in Pontos, and copper is broken (17: Aristotle, see p. 100, more correctly confined this effect to tin). Quicklime (κονία), plaster of Paris (γύψος), and mineral soda which has been burnt (τὸ νίτρον τὸ κεκαυμένον ἐν τῷ ὀρύττεσθαι), all become hot with a little water (ὅταν γὰρ ὕδωρ μικρὸν ἐπιχυθῇ διαθερμαίνει καὶ αἴσθησιν ἐμποιεῖ κατὰ τὴν ἁφήν) (65–6). Theophrastos's extant works contain little on salts (see p. 123). There is a mention of salty, 'nitrous', and aluminous juices and waters (ἁλμυρὰ, νιτρώδη, στυπτηριώδη χυλὸς) and the use of soda (νίτρον) in watering cabbages in Egypt.[2] A treatise on waters (F) says Nile water contains soda (λίτρον). Cold contracts water and makes it thicker (σωματώδη) and heavier, so that water clocks run more slowly in winter. Ice and snow waters are lighter and good (cf. Hippokrates, p. 29).[3]

On Stones

The most interesting work of Theophrastos from our point of view is the treatise *On Stones* (G), which (with translations) has been printed several times:

G[1]. *Theophrasti de lapidibus liber, ab Adriano Turnebo Latinitate donatus.* Ex officina F. Morelli, 4°, Paris, 1577 (15 pp.) (BM 726. d. 1. (1.); Hoefer, (1), i, 101, quotes an ed. of 1574.

G[2]. With J. de Laet, *Gemmarum et Lapidum Historia*, 3 ed. (by de Boodt and Tollius), Leyden, 1647, sep. t.p.: *De Gemmis et Lapidibus Libri Duo. Quibus præmittitur Theophrasti Liber de Lapidibus Græce & Latine. Cum Brevibus Annotationibus* (24 unnumb. ll.); see Vol. II, p. 101.

G[3]. In K, i, 686–705 (text); ii, 424–35 (Turnebus' tr., G[1]); iv, 535–93 (notes).

G[4]. In L, 340–50 (the text quoted below by paragraph, unless otherwise stated).

Text and English tr. by Sir John Hill (see Vol. III, p. 214):

G[5]. *Theophrastus's History of Stones. With an English Version, and Critical and Philosophical Notes, Including the Modern History of the Gems, &c. described by that Author; and of many other of the Native Fossils. To which are added, Two Letters: One . . . On the Colours of the Sapphire and Turquoise. And the Other . . . Upon the Effects of different Menstruums on Copper. Both tending to illustrate the Doctrine of the Gems being coloured by Metalline Particles*, 1746 (pp. xxiv, 212).

G[6]. Ditto, same title but 'Critical and Philosophical' omitted and additional: '*The Second Edition; Enlarged by the Addition of a Greek Index of all the Words in Theophrastus. Also Observations on the New Swedish Acid, and of the Stone from which it is obtained; and with An Idea of a Natural and Artificial Method of Fossils*, 1774 (pp. viii, 342, xxx Greek index, xvi general index. Berliner, *Science*, 1927, lxvi, 192, says it was reprinted in 1774 with a different pagination.

G[7]. *Traité des pierres de Théophraste, traduit du Grec, avec des notes physiques et critiques, traduit de l'Anglois de M. Hill*, 1754 (no Greek text).

[1] Hoefer, (1), i, 102: 'il n'est pas irrationnel de croire que la flamme est entretenue par un souffle ou corps aériforme'; Gilbert, 199: πνευματα = ἀήρ.

[2] B, II, v, 1, 3.

[3] H, clix; L, 452, from Athenaios, ii, 15–17.

G[8]. *Theophrast von den Steinen, griechisch und deutsch, mit Hills physikalischen und kritischen Anmerkungen*, ed. Baumgärtner, Nürnberg, 1770 (BM 973. a. 4). Lippmann, (e), i, 283, calls it an 'erstaunlich gute deutsche Übersetzung'; Fabricius, (1) (*b*), iii, 424, says it contains Hill's text conjecturally 'restored' with no use of MSS. Another German tr. is: *Abhandlung von den Steinarten*, K. C. Schmieder, Freyberg, 1807, q. in his *Geschichte der Alchemie*, 1832, 60.

G[9]. *Theophrstaus on Stones*, intr., text, tr., and comment., by E. R. Caley and J. F. C. Richards, Columbus, Ohio, 1956.

It contains hardly any theoretical speculation and hardly a trace of the superstition of the later 'lapidaries', which follow a different tradition although sometimes it speaks of 'male' (dark coloured) and 'female' (light coloured) stones. The identifications of ancient gems and minerals is difficult and often conjectural (see p. 132).[1] The numbers in the text refer to paragraphs in L.

Among bodies forming the interior of the earth some owe their origin to water, viz. the metals (ὕδατος μὲν τὰ μεταλλευόμενα; cf. Plato, p. 60), and some to earth, viz. stones (1). These bodies have been formed by the concretion of a pure homogeneous matter (ἐκ καθαρᾶς τινος συνεστάναι καὶ ὁμαλῆς ὕλης) (i) by afflux (συρροῆς), or (ii) percolation (διηθήσεώς), or (iii) separation of impure matter in the midst of which it once found itself (ὡς ἀνωτέρω εἴρηται καὶ κατ' ἄλλον τρόπον ἐκκεκριμένης) (2). Some substances owe their concretion to cold, others to heat; stones may arise from both causes, but earth seems to arise from heat only (3). Some stones are fusible, others will not liquefy in the fire and may be calcined, others are incombustible. The differences of density, etc., owe their origin to the particles of matter of which the substances are formed, and to the way in which these are united.

Some stones petrify (ἀπολιθουν) whatever is contained in vessels made of them, others have an attractive virtue (δὲ ὁλκήν) (4). The most remarkable power (δύναμις) is that of producing birth (τικτόντων), if it is true (εἴπερ ἀληθὲς) (5).[2] Some stones are cut with difficulty by steel, but are cut with other stones (5, 41–43). Stones which do not contain moisture do not burn (19); some stones fly to pieces in the fire like some kinds of earthen vessels these are the absolutely dry varieties, since the fusible ones contain moisture which they keep to the point of fusion (10). Crystal shapes are hardly mentioned (19, ἑξάγωνα). Male and female stones are darker and lighter in colour, respectively (28, 30).[3]

Stones (λίθων) differ in nature. Some contain gold and silver, or only silver, and are heavy in weight and smell (39). Some are earthy (εἰσι γῆς) like ochre and ruddle (ὦχρα καὶ μίλτος), others sandy (οἷον ἄμμου) like ***chrysokolla*** (χρυσόκολλα) and ***kyanos*** (κύανος), others dusty (κονίας) like realgar (σανδαράκη) and orpiment (ἀρρενικόν) (40).[4] Stones of a metallic kind, as silver,

[1] Babelon, DS, II, ii, 1461; Blümner, iii, 60 f., 227 f.; Furtwängler, iii, 384–97; U. T. Holmes, *Speculum*, 1934, ix, 195; C. W. King, (1); Krause; L. de Launoy, *Minéralogie des Anciens*, 2 vols., Brussels, 1803; Lenz, (3), 16 f. (from Hill); Middleton, 129 f.; N. F. Moore, *Ancient Mineralogy*, 1869; Regenbogen, PW, 1940, Suppl. vii, 1415; Rossbach, PW, vii, 1101; Stephanides, *Rev. Étud. Grec.*, xxix, 197; 1922, xxxv, 296–320; *Isis*, 1925, vii, 468 (475); T. Thomson, (2), 1817, iii, 240; (3), 180.

[2] This stone is called *aëtites* by Pliny, xxx, 44; xxxvi, 39; and Dioskourides, v, 161.

[3] Blümner, iii, 257, 263; Krause, 15, 45, 69, 83; Nies, PW, i, 704; Rossbach, PW, vii, 1108; Seidel, MGM, vi, 259.

[4] Lenz, (3), 25; see p. 96.

copper, or iron, melt in furnaces by reason of the water in the metals they contain, and similarly *pyromachoi* (οἱ πυρομαχοι) and *muliai* (οἱ μυλίαι) (9).[1]

The stone which tries gold (βασανιζούσης τὸν χρυσόν) seems to have the same power as fire, which also tests of that metal, yet the two are different. The trial by fire is by the change of colour (τὰ χρώματα μεταβάλλειν καὶ ἀλλοιοῦν),[2] but that by the stone is made only by rubbing the metal on it, the stone seeming to have the power of receiving separately the particles of different metals (δύναται γάρ, ὡς ἔοικεν, ἐκλαμβάνειν τὴν ἑκάστου φύσιν) (45).[3] There is a better stone which serves not only for the trial of refined gold but also of gold coloured with copper or silver, and shows how much adulterating matter by weight is mixed with gold. This has signs which it yields from the smallest weight of the adulterating matter, which is a grain (κριθή), from thence a collybus (κόλλυβος), and thence a quadrans (τετρατημόριον) or semi-obulus (ἡμιώβολος), by which it is easy to distinguish if and in what degree the metal is adulterated (46).[4] All these stones are found in the River Tmolos (in Lydia). They are smooth and broad; the upper surface which has lain towards the sun acts better than the lower, which is moist and this hinders the adhesion of metal. For the same reason it acts better in cold weather, for in hot weather it exudes moisture (47).[5] The touchstone was mentioned before by Plato (see p. 65) and Aristotle (see p. 99), but Theophrastos first described it in more detail.[6] He also mentions (4) the Herakleian or Lydian stone (λίθος Ἡράκλεια καὶ ἡ Λυδή) serving for 'the trial of gold and silver (δὲ βασανίξειν τὸν χρυσὸν καὶ τὸν ἄργυρον)'. He does not use the name βασανος for the stone itself; this word is Oriental.[7] The unnamed stone (λίθος) which attracts iron (ἡ τὸν σίδηρον ἄγουσα) (29) is the magnet which was also (but not by Theophrastos) called Ἡράκλεια λίθος.[8] Theophrastos says[9] the magnet (ἡ λίθος)

[1] Isidore of Seville, *Orig.*, XIX, x, 10, says *molares* are of four kinds: *albus* (pumice ?), *niger* (basalt ?), *permixtus*, and *fistulosus*; Blümner, ii, 65; Gsell, 71; Lenz, (3), 150; T. Thomson, (3), 1817, iii, 302 (*pyromachoi* = flint). Ovid, *Fasti*, vi, 318, mentions pumice as a common material for millstones, and this is fusible; Strabo, VI, ii, 3, 269C. (lava, ῥύαξ from Etna); X, v, 16, 488C.; Blümner, i, 28; iv, 219; see Aristotle. Pliny, however, xxxvi, 53, says the best quicklime, of a more fatty nature (pinguior natura), is made from *molares*, here evidently limestone.

[2] Hill, G[6], 186, has καὶ ἀξιοῦν, reading 'change of colour and quantity', which seems preferable.

[3] Turnebus: Ignis enim probat coloris mutatione et alteratione, lapis attritu: is enim est, qui possit, ut videtur, cuiusque naturam excipere; Hill, G[6], 186–191 has a long note on the matter.

[4] The text is corrupt; Schneider, G[3], has a long note on the alteration of χαλκὸν κατάχρυσον (in Hill, G[6]) to κατάχαλκον χρυσὸν (adopted by Wimmer, G[4]); Theophrastos is really comparing pure gold with gold mixed with copper and silver, not copper with gold and silver.

[5] Pliny, xxxiii, 43, says the stone 'called *coticula* formerly, according to Theophrastos, was found only in the river Tmolus, but it is now found in many parts . . . those experienced with the *coticula* when they rub ore (*vena*, probably an incorrect rendering of Theophrastos's "metal") with it can say at once how much gold it contains, how much silver and copper, and this to a scruple'.

[6] Blümner, iv, 136; Jacob, DS, 1887, I, ii, 1548; Perrot and Chipiez, ix, 97.

[7] H. Lewy, *Die semitischen Fremdwörter im Griechischen*, 1895, 61, suggested from Hebrew *pâz*, refined gold, *pâzaz*, refining gold and silver; Muss-Arnolt, *Trans. Amer. Philol. Assoc.*, 1892, xxiii, 35–156 (146), gives derivations from Bāshan, or Sanskrit *pāṣana*.

[8] Clement of Alexandria, *Strom*, ii, 6; vii, 2 (who says its power can be diffused over many steel rings 'by affinity'); Hesychios, ed. Schmidt, Jena, 1861, ii, 62: μαγνῆτις λίθος αὕτη πλανᾷ ὄψιν, ἀργύρῳ ἐμφερὴς οὖσα; ἡ δὲ Ἡρακλεῶτις τὸν σίδηρον ἐπισπᾶται; Hill, G[6], 10, 134; Rommel, PW, xiv, 474; Salmasius, (1), 775.

[9] A, IX, xviii, 2; G. §§ 28–9.

and amber (τό ἤλεκτρον) attract things to themselves. The μαγνῆτις λίθος (41) is different, since it is like silver (ὁμοίωσιν τῷ ἀργύρῳ) and is cut and shaped by the turner (τορνευτοὶ); it may have been magnesite or plumbago.[1]

Some stones which burn when thrown on the fire and blown upon and give out a disagreeable smell are found in mines near Bina (in Thrace) (12).[2] Spinos (σπῖνος), found in mines (ἐν τᾶς μετάλλοις), burns when cut in pieces and exposed in a heap to the sun; it burns more easily if wetted with water (13).[3] A stone looking like rotten wood, found in mines in Skaptehyle, burns if oil is poured on it (17).[4] A bituminous stone found in the promontory of Erineos burns and exhales fumes, leaving a mass like burnt earth (15). What is commonly called coal, dug for use from mines (οὓς δὲ καλοῦσιν εὐθὺς ἄνθρακας τῶν ὀρυττομένων), is earthy (γεώδεις) but burns like charcoal (πυροῦνται καθάπερ οἱ ἄνθρακες). It is found in Liguria with amber (τό ἤλεκτρον) and in Elaia, and is used by smiths (16).[5] This is the first definite Greek mention of mineral coal and its use in metallurgy.

Two kinds of cinnabar (κιννάβαρι) are: (i) natural (αὐτοφυὲς), hard and stony, found in Spain and Colchis (where it is shot down from rocks by arrows), and (ii) artificial (κατ' ἐργασίαν) made in small quantities near Ephesos, a sand (ἄμμος) shining like scarlet (κόκκος), which is ground in stone mortars and repeatedly levigated in copper and then wooden vessels, the part settling being cinnabar, whilst the part that floats is worthless. Kallias, belonging to the Athenian silver mines, ninety years ago, thought the sand contained gold, but finding it did not, he invented this process of making the colour (58–9). The first kind would be true cinnabar (mercuric sulphide), since Theophrastos (60) says mercury (χυτός ἄργυρος) is made for amusement and use by grinding cinnabar with vinegar (μετ' ὄξους) in a copper mortar with a copper pestle (ἐν ἀγγείῳ χαλκῷ καὶ δοίδυκι χαλκῷ), which would give copper amalgam rather than pure mercury, the preparation of which is first described by Dioskourides.[6] Mercury was known to Aristotle (see p. 101).

Fossil ivory (ὁ ἐλέφας ὁ ὀρυκτὸς), variegated black and white, (37) may have been fossil teeth; fossil bones[7] occur in large masses in Attica.[8]

Marble (μάρμαρος) gives quicklime (κονία) on burning (9).[9] The stone ὁ χερνίτης, like ivory (6), was probably white marble.[10] The stone ὁ

[1] Blümner, iii, 278; Hill, G^6, 177 ('ollaris', soapstone); Krause, 124 (magnetite); Lippmann, (2), i, 384 (mica or talc), 621 (haematite); Rommel, PW, xiv, 474.

[2] On the Thracian stone, see Aristotle, Hill, G^6, 54, says Salmasius altered τῇ θραύσει to τῇ καύσει, as in L, 312; possibly iron pyrites is meant.

[3] Salmasius, (1), 179, suggested σπίλος; Hill, G^6, 56, a bitumen; Lenz, (3), 18, pyritous schist.

[4] Lenz, (3), 19: black wad.

[5] Blümner, iv, 215 (lignite; ἄνθραξ, *carbo*, is wood charcoal; λιθάνθραξ is *mod*. Greek for mineral coal, corresponding with ἄνθραξ γηώδης in Theophrastos); Hill, G^6, 64 (pit-coal); Lagercrantz, PW, xi, 1038 (mineral coal); Lenz, (3), 19 (do.); Turnebus (tr. οἷς καὶ οἱ χαλκεῖς χρωνται as iisque fabri ferrarii utuntur).

[6] v, 110.

[7] Pliny, xxxvi, 29.

[8] Lenz, (3), 149. Prinsep, JASB, 1832, i, 353 (362), suggested fossil bones impregnated with iron phosphate, which become turquoise-blue on heating.

[9] Not all μάρμαρος was marble; it formerly meant a 'block of rock'; the usual name is λίθος λευκός, white stone, Blümner, iii, 9, 27–8, 171; Theophrastos, § 6, mentions Parian, Pentelican, Chian, and Theban marbles; Hill, G^6, 35.

[10] Hill, G^6, 38; Carrara (the Etruscan Luna) was an old source of white marble, Pliny, xxxvi, 5.

πόρος, white and hard like marble but very light, used in Egypt for internal walls (7), may have been magnesite. Alabaster ἀλαβαστρίτης (6), dug in Egypt near Thebes, was used to make perfume vessels (ἀγγεῖα ἀλαβάστρους).[1] Pumice (κίσσηρις), and Liparian stone (λιπαραῖος λίθος), very like pumice in colour and density after burning but black and compact before, are found together (14).[2] Froth of the sea (ἀφρος τῆς θαλάσσης) (19) is probably the coralline called *alcyonium* by Pliny.[3] The stone διάβαρος, which does not form pumice on burning (οὐ κισσηροῦται) (20), may be διάβορος (porous) some kind of volcanic stone.[4] Many gems are named by Theophrastos (see p. 129).

Kyanos (ὁ κύανος) (39) is perhaps lapis lazuli, or azurite (basic copper carbonate).[5] By grinding it four different shades are produced, the finest parts the lightest and the coarsest the darkest (55). It is found in gold, silver, and copper mines and there are male (darker) and female kinds (31).[6] There is a native (αὐτοφυής, αὐτόματος) kind; an artificial (τεχνική) kind is made (σκευαστός) in Egypt, Scythia, and Cyprus. The Egyptian is better for bright paintings (ἄκρατα λειώματα), the Scythian for pale. The historians of Egypt recorded the name of the king who invented it; the Phoenicians pay tribute in it (55).[7] *Κύανος* contains χρυσοκόλλα (39).[8] Chrysokolla ('gold solder') (26, 51)[9] is malachite (giving pure copper on reduction and hence used for soldering gold);[10] it is found in large quantities in gold mines and even more plentifully in and near copper mines, sometimes in silver mines. The bastard emerald (ψευδὴς σμάραγδος) is found in copper mines in Cyprus and on an island opposite Carthage, small pieces being used for soldering (κόλλησιν) gold instead of chrysokolla, which they resemble in colour (25–6). The αἱματίτις (37), dense and like dry blood (αἵματος ξηροῦ πεπηγότος), is haematite; a yellow (ξανθή) kind is perhaps limonite.[11]

Amber (τό ἤλεκτρον λίθος), found in Liguria, has an attractive power (δύναμις ἀκολουθέιη) (16, 29).[12] Lynkourion (λυγγούριον), very hard and engraved, has an attractive power like amber but Diokles says it attracts straws and bits of wood, and also copper and iron if they are beaten out very thin (ἐὰν ᾖ λεπτὸς). The lynx hides its urine by heaping earth about it; the stone from the wild animal is better than that from the tame, and from the male than from the female (28).[13]

[1] O, 41; Blümner, iii, 61.

[2] Liparian stone may be obsidian or basalt; Blümner, iii, 273.

[3] xxxii, 27; Hill, G[6], 85, disagrees.

[4] LSJ, 390; Hill, G[6], 86, read 'Αραβικὸς λίθος (*Arabicus lapis*) from Dioskourides, v, 149, which Pliny, xxxvi, 41, says is a kind of pumice; Dioskourides, v, 125, quotes Theophrastos as saying that pumice at once stops vinous fermentation.

[5] Hendrie, 77 (κύανος = azurite, σάπφειρος = lapis lazuli); Salmasius, (1), 92 f., 142 f.; (2), 217 (late Greek λαζουρι or λαζοῦριον is derived from 'azure').

[6] Solinus, 15, also speaks of *chalcosmaragdus* in copper mines.

[7] For this 'Egyptian blue', see Partington, (1), 117; Vitruvius first gave the method of preparation.

[8] Lepsius, (1), 29 f., 43, 62, thought χρυσοκόλλα should be χρυσοκονίαν, 'gold dust', the sprinkling of golden pyrites in some lapis lazuli (the letters *ΛΛ* being replaced by *ΝΙ*).

[9] Also mentioned in ψ-Aristotle, *De Mirab.*, 58, 834*a*.

[10] Blümner, iv, 296 f., 504; Hill, G[6], 119 f., 205; Hoefer, (1), i, 101; Jacob, DS, 1887, I, ii, 1133 (wrongly 'borax'); Kopp, (1), iv, 167; Lenz, (3), 21.

[11] Furtwängler, i, 397; Hill, G[6], 163; Pliny, xxxvii, 60.

[12] Hill, G[6], 133.

[13] Pliny, xxxvii, 11, reported from Demostratus that *lyncurion*, lynx urine, is amber; probably λυγγούριον, derived by false etymology from λύγξ + οὖρον, lynx urine, comes from the

Coral (τό κουράλιον) is stony, red, round like a root, and grows in the sea (38). Coral is first mentioned in Greek by Pindar (5 cent. B.C.) as 'lily-flower of the sea (λείριον ἄνθιμον ποντίας ἐέρσης)'.[1] The 'petrified Indian reed (ὁ Ἰνδικὸς κάλαμος ἀπολελιθωμένος)', not very different from coral (38), has been identified with a fossil coralloid,[2] black Indian coral (*Gorgonia antipathes* L.),[3] or (improbably) *ṭabāshīr*.[4]

Four kinds of earth are Melian (μηλιάς), Kimolian (κιμωλία), Samian (σαμία), and Tymphaikan (τυμφαϊκή), the last sometimes called gypsum (γύψος) and used for cleaning clothes (i.e. fuller's earth; true gypsum is calcium sulphate). The Melian is used by painters, the Samian, although more beautiful, is too fatty, dense, and unctuous (62–4).[5] Earth may be liquefied, changed in consistence, and finally hardened (τήκεσθαι καὶ μαλάττεσθαι καὶ πάλιν ἀποσκληρύνεσθαι). It melts like stones when mixed with mineral and fusible substances. It is softened and made into several kinds of bricks by moistening and burning (48). Glass (ὁ ὕελος), it is said, is made from ὑελῖτις (a vitrifiable sand ?) by the extreme force of fire (πυρώσει Hill; πυκνώσει Wimmer). The best kind is mixed with copper in the fluid mass (τῷ τήκεσθαι καὶ μίγνυσθαι) which gives a clear colour (κάλλει τῆς χρόας ποιεῖν διαφοράν) (49).[6]

Some earths petrify, some are food for plants, others are coloured and used as pigments, others seem as if burnt and changed by fire, as realgar (σανδαράκη) and orpiment (ἀρρενικόν), but all these seem to arise from dry smoky exhalation (ἀπὸ τῆς ἀναθυμιάσεως ταῦτα τῆς ξηρᾶς καὶ καπνώδους) (50). Yellow ochre is found in heaps, red ochre (μίλτος) scattered here and there; the painters use them instead of orpiment and realgar, from which it is difficult to distinguish them when they are powdered, however different they may appear in mass. The best ochres come from Cappadocia, where the miners are in danger of suffocation, but the best red ochre, of which there are several kinds, comes from pits in Keos and sometimes from iron mines (51–2).[7] In Herodotos,[8] and probably in Aristotle,[9] μίλτος is ruddle (red ochre), but in Pliny[10] it could include red lead (Pb_3O_4) and cinnabar (HgS).

name of the Ligurians (Λιγουρία in Ptolemy but Λιγυστική in earlier authors), who were said to have gathered λιγγούριον 'called by some amber (ἤλεκτρον)', Strabo, IV, vi, 2, 202C (they probably traded in Baltic amber); Pliny, viii, 57, also says solidified lynx urine is the same as amber. Hill, G[6], 124–32, says Woodward suggested belemnites, Gesner amber, Epiphanios called it λαγγούριον λίθος, and Hill suggested that it was the hyacinth, which was accepted by Beckmann, (1), 1846, i, 86. W. Watson, *Phil. Trans.*, 1759, li, 394, suggested tourmaline (which becomes electric on heating), accepted by T. Thomson, (2), 1817, iii, 278. See Lenz, (1), 144; (3), 21; Lippmann, (2), i, 384; Thorndike, in Sudhoff, (1), 85. Loukian, (1), iii, 259, in his essay on amber, and Aelian, *De Nat. Animal.*, iv, 17, give the lynx story.

[1] Schrader, (1), 456; the *name* is first in Theophrastos; τό κοράλλιον in *Periplus*, 28, 39, 49, 56; and Dioskourides, v, 139; Schrader, (1), 457, derives it from κόρη ἁλός, 'daughter of the sea'. Pliny, xxxii, 11, and Solinus, 2, say it was used medicinally as an amulet; Hill, G[6], 164.

[2] Hill, G[6], 169.

[3] Lenz, (3), 23.

[4] Lippmann, (2), i, 15; (3), ii, 80: 'Steine hervorbringende Rohren Indiens.'

[5] Blümner, iv, 468; Dioskourides, v, 180; Galen, *Simpl. fac. med.*, ix, 1–4, Kühn, xii, 168 f.; Hill, G[6], 239; Lenz, (3), 27; Pliny, xxxv, 53–9; Salmasius, (1), 182.

[6] Hill, G[6], 197 f., ὑελίτιδος for ὑελίδος from Salmasius, χαλίκι, flints, for χαλκῷ in de Laet.

[7] Some of these kinds are realgar, since Strabo, XII, iii, 40, 562C, describes the realgar mine, σανδαρακούργιον, in the Pontos, worked by slaves who soon die from the poisonous smell emitted by the mineral.

[8] iv, 191; vii, 69.

[9] *Meteor.*, iii, 6, 378*a*.

[10] xxxiii, 36–41.

An artificial ochre, not as good as the natural, invented by Kydias, when half-burnt becomes purple (ἡμίκαυστον καὶ πεφοινιγμένην). The ochre in new earthen pots luted with clay (περιπλάσαντες πηλῷ) is put in furnaces. The hotter the fire, the darker and more burnt (μελαντέραν καὶ ἀνθρακωδεστέραν) it becomes; the different colours of natural ochres may have the same or a similar origin (53–4).

Gypsum (γύψος) occurs in large quantities near the surface in Cyprus, also in Phœnicia, Syria, and other places. The stone from which plaster is made by burning is like alabaster. The viscidity and heat produced on wetting [plaster of Paris] are wonderful (ἡ δὲ γλισχρότης καὶ θερμότης ὅταν βρεχθῇ θαυμαστή). It is mixed with water immediately before use in building by stirring with wooden instruments, since the heat would burn the hand. This plaster hardens quickly and is very strong, lasting when the stones have crumbled; it can be taken off and burnt again. It is used in Italy for whitening walls inside houses (64–6).[1] It is also used by painters and fullers, and is excellent for casts, for which it is mostly used in Greece. It acquires on moistening a heat greater than that of lime and a ship containing it was set on fire when it became wetted (67–9).[2]

Some preparations are made by art, as white lead (ψιμύθιον), by putting lead (μολύβδος) in earthen vessels over vinegar (ὑπὲρ ὄξους). 'After the lead has acquired a kind of thick rust, which usually happens after about ten days, the vessels are opened and the rust scraped off, as if it were a kind of dross. The lead is put again over the vinegar and the operation of scraping is repeated till it is entirely corroded away. That which has been scraped off is then powdered and boiled with water for a long time. That which falls to the bottom is white lead (56).' Verdigris (ἰός) is made in a similar way; red copper (χαλκὸς γὰρ ἐρυθρὸς) is put over grape marc (ὑπὲρ τρυγὸς) and the rust it contracts is scraped off (ἀποξύεται τὸ ἐπιγινόμενον) (57).

Other Works

The work on sense perception (περὶ αἰσθήσεως καὶ αἰσθητῶν, *de sensu et sensibilibus*)[3] is perhaps part of a large book on physics (φυσικῶν δόξαι) by Theophrastos. Some small treatises (contained in L) are on winds (περὶ ανέμων) and weather signs (περὶ σημείων ὑδάτων καὶ πνευμάτων καὶ χειμώνων καὶ εὐδιῶν) — perhaps part of the work on meteorology,[4] on weariness (περὶ κόπων), swooning (περὶ ἰλίγγων, π. λειποψυχίας), sweat (περὶ ἱδρώτων), and paralysis (περὶ παραλύσεως). Lost works listed by Diogenes Laertios include: (i) on metals (περὶ μετάλλων),[5] (ii) *On Coagulation and Fusion* (περὶ πήξεως

[1] Hill, G[6], 259, read from Salmasius εἰς τὴν κονίασιν, whitening walls, instead of εἰς τὴν οἰκεῖον in the MSS.; Turnebus took εἰς τὸν οἶνον, vino gypsum indunt; Wimmer adopted this, ad vinum condiendum, i.e. plastering wine; Pliny, xxxvi, 55, mentions both white-washing with slaked lime, and xiv, 24–5, removing acidity from wine by adding gypsum; Blümner, ii, 140.

[2] Blümner, iii, 102, thought Theophrastos confused plaster with quicklime.

[3] L, 321–40.

[4] J. G. Wood and G. J. Symons, *Theophrastus on Winds and on Weather Signs*, 1894; Bergsträsser and Boll, *Sitzb. Heidelberg Akad., phil.-hist. Kl.*, 1918, no. 9, on fragms. in Arabic.

[5] Mentioned in G, § 1: τῶν μεταλλευομένων ἐν ἄλλοις τεθεώρηται.

καὶ τήξεως), (iii) *On Salt, Soda and Alum* (περὶ ἁλῶν, νίτρου, στυπτηρίας),[1] (iv) two books on petrifactions (περὶ τῶν λιθουμένων), (v) on juices,[1] (vi) on animals and, (vii) one book on meteorology. Other works were on logic, ethics, politics, history of philosophy, and psychology. Diogenes Laertios says the complete works contained 232,908 lines. A work on mines (μεταλλικόν) by Philon, a friend of Aristotle,[2] is lost.

Straton

Straton (Στράτων) (Strato) of Lampsakos (328 ?–270/68 B.C.) succeeded Theophrastos as head of the Lyceum (286 B.C.). He was previously a teacher of Ptolemy II (Philadelphus) in Alexandria. He wrote works on logic, ethics, and the history of philosophy, but was especially interested in physical science, so that he was called 'the natural philosopher (ὁ φυσικός)'. He had no doubt felt the practical tendency in Alexandria; his experimental activity may have been aroused there. Straton's writings are now known only from the list in Diogenes Laertios[3] and in extracts in commentators of Aristotle, Cicero, etc.[4]

A small part of the preface of the *Pneumatika* of Heron of Alexandria (see p. 206) is quoted by Simplikios as Straton's and hence Diels thought that the whole may be his, perhaps taken by Heron by way of Philon of Byzantium or Ktesibios (who may have met Straton in Alexandria) from a treatise on the vacuum (περὶ κενοῦ) by Straton. This assumption has been fairly generally accepted, but the relevant passage will be dealt with under Heron. Straton was perhaps influenced by Herakleides of Pontos, who assumed primary particles (ἄναρμοι ὄγκοι), 'disconnected molecules' separated by a vacuum, which formed the world not by mechanical means but by divine guidance, and Straton may have passed on this theory to Asklepiades of Prusa (see p. 185).[5]

Pupils of Straton were the physician Erasistratos (see p. 183),[6] perhaps Ktesibios, and Aristarchos of Samos (active *c.* 280 B.C. and may have lived to 264 B.C.).[7] Straton also influenced the commentator Alexander of Aphrodisias, who taught in Athens in A.D. 198–211,[8] and Aristotelian philosophy as modified by Straton reached the Arabs through him.[9]

Straton apparently returned to the theory of four elements, rejecting the ether as a fifth.[10] He said colour is produced by a dissolution (ἀποφορά) of the coloured surface, which communicates the colour to the medium (air), and so it reaches the eye.[11] He noticed that the electric shock of the torpedo (νάρκη)

[1] Mentioned in B, II, v, 1. [2] Athenaios, vii, 119; xiii, 92.
[3] v, 3, 58 f.; ed. Cobet, Paris, 1850, 124–6.
[4] Capelle, PW, 1931, II Reihe, vii, 278–315; Deussen, (1), II, i, 388; Diels, *Sitzb. Akad. Berlin, phil.-hist. Kl.*, 1893, 101–27; Farrington, 1949, i, 29–35; Gilbert, 192; Gomperz, (2), iv, 503, 579; Lasswitz, (1), i, 214; G. Rodier, *La Physique de Straton*, 1890 (BM 7004. bb. 41); Ueberweg, (1), i, 345, 484; Zeller, (1), II, ii³, 897–921.
[5] Ueberweg, (1), i, 345. [6] Zeller, (1), II, ii³, 901.
[7] Gomperz, (2), iv, 504; Hultsch, PW, ii, 873; on Aristarchos of Samothrace, the Alexandrian grammarian, *c.* 156 B.C., Cohn, PW, ii, 862; or another Aristarchos, an obscure physician, *c.* 250 B.C., Wellmann, PW, ii, 862.
[8] Ueberweg, (1), i, 564.
[9] Deussen, (1), II, i, 338, 359.
[10] Gilbert, 192; Zeller, (1), II, ii³, 913.
[11] Diels, 119; cf. Theophrastos, *De sensu*, 50 (Demokritos's theory).

can pass through copper or iron.[1] Straton rejected Aristotle's division into matter and form; pure form is as unthinkable as pure matter. Natural phenomena are due to an immanent necessity (*αὐτόματον*) and not to an extramundane cause or God, unless he is identical with Nature. In so anticipating Spinoza, Straton was accused of atheism in trying to explain phenomena physically.[2] The *νοῦς* was the animal soul, material and situated between the eyebrows. Thought and perception are identical and both due to motion. The natural causes, as with Aristotle, are still inherent qualities (*ποιότητες*) and powers (*δυνάμεις*), the most important being heat and cold.[3]

The elements do not seek their places 'by nature', as Aristotle said, but by displacement, the lighter being thrust upwards and the heavier tending to sink, and so the order earth, water, air and fire is established. All bodies have weight and tend to the centre.[4] The substratum of cold is water, that of heat is steamy vapour or fire. Heat and cold are always opposed; when one enters the other is driven out.[5] This violent antipathy was the cause of earthquakes and of thunder and lightning.[6]

Works attributed to Straton by Diogenes Laertios[7] are on colours (*περὶ χρωμάτων*), mixtion (*περὶ μίξεως*), heavy and light (*περὶ κούφου καὶ βαρέος*), the vacuum (*περὶ τοῦ κενοῦ*), mining machinery (*περὶ τῶν μεταλλικῶν μηχανημάτων*), and[8] two books on inventions.

Eudemos of Rhodes (fl. *c.* 375 B.C.), a friend of Theophrastos, compiled a paraphrase of Aristotle's *Physics*. Andronikos of Rhodes (*c.* 70 B.C.) arranged the works of Aristotle and became head of the Lyceum soon after 40 B.C. One of the last members of the school was Alexander of Aphrodisias (*c.* A.D. 200).

[1] Theophrastos, H, 178; L, 461, knew this. See Galen, p. 192.
[2] F. P. Schlosser, *Spicilegium historico-philosophicum de Stratone Lampsacenseno, cognomento Physico et atheismo hylozoico vulgo ipsi tributo*, 4°, Wittenberg [1728] (BM T. 988. (5.)); C. Nauwerck, *De Stratone Lampsacenso philosopho disquisitio*, Berlin, 1836 (BM 8460. c.c. 19).
[3] Fabricius, (1) (*b*), iii, 506; Windelband, (1), 179; Zeller, (1), II, ii³, 907.
[4] Gomperz, (2), iv, 502; Zeller, (1), II, ii³, 908.
[5] Zeller, (1), II, ii³, 907; Seneca, *Quaest. Nat.*, VI, xiii, 2, gives this theory as Straton's. The alchemist Zosimos (*c.* A.D. 250) gives the same theory: *αἱ ποιότητες δι' ἀλλήλων παρέχονται*; Berthelot, (2), ii, 150.6; iii, 152 (attributes it to Aristotle — antiperistasis, Lippmann, (2), i, 37.
[6] Zeller, (1), II, ii³, 907; this idea reappeared in the 17 cent. with Kunckel and Mayow.
[7] v, 3, ed. Cobet, 1850, 124–6.
[8] Also by Clement of Alexandria, *Strom.*, i, 14, 16.

CHAPTER VI

EPIKOUROS

Epikouros (Ἐπίκουρος, Latin Epicurus) based his philosophy on Demokritos and was not much influenced by Plato and Aristotle. He was born of Athenian parents on the island of Samos in 342/1 B.C., and died in Athens in 271/70 B.C. Much of his theory comes from Demokritos, perhaps almost literally,[1] but modified and improved in several important directions.[2] His claims for originality (he said he was self-taught)[3] are exaggerated and his personal abuse of his teacher Nausiphanes of Teos (see p. 48) is ungenerous. The picture of the morals of Epikouros and his school drawn by comic poets, rival philosophers, and the fathers of the Church, is distorted, and is at variance with what is known of his life.[4] Epikouros came from Lampsakos to Athens in 306 B.C. and set up a philosophical community in his garden, hence his school is called that of 'the garden'. At that time, Athens had degenerated into a vulgar plutocracy. By all the numerous members of his school, Epikouros was venerated, almost worshipped.[5]

The writings of Epikouros were voluminous and large fragments remain.[6] The chief source is Diogenes Laertios, Book X, and the 'Letter to Herodotos' in this (referred to below as Ep. i, with section number in Diogenes Laertios as in Bailey (2)) contains much of the physical theory. Papyrus rolls were also found at Herculaneum in 1793. The chief aim of Epicureanism was the attainment of a happy life; philosophy, the study of which required no previous preparation, served to set aside religious ideas which might disturb the wise man. Apart from practical purposes it had little use for physical theories. The gods existed, enjoying an undisturbed life in the spaces between the worlds which they had not created; they ate, perhaps slept, and spoke Greek, but completely ignored human affairs;[7] neither they nor men should be

[1] Ueberweg, (1), i, 442; Cicero, *De fin.*, i, 6; ed. Bentley, Cambridge, 1718, 14: Quæ sequitur sunt tota Democriti: atomi, inane, imagines quæ idola nominant.

[2] C. Bailey, (1), 529 f.

[3] Diogenes Laertios, x, 13.

[4] C. Bailey, (1), 218 f., 226 f.; Mahaffy, (1), 142; G. Murray, (1), 129 f.; Tarn, (1), 294.

[5] Atanassiévitch; Baeumker, 301; C. Bailey, (1), 217 f.; Brandis, (1), III, ii, 11, 19 f., 431; Cudworth, i, 138; iii, 116; Deussen, (1), II, i, 430 f.; Gilbert, 205; R. D. Hicks, 157, 203 f.; Lange, 74; Mabilleau, 267; Mallet, NBG, 1856, xvi, 140; Nestle, (2), i, 167; Partington, *Ann. Sci.*, 1939, iv, 245; Robin, (1), 323; Sarton, *Isis*, 1929, xiii, 123; W. Schmidt, *Epikurs Kritik der platonischen Elementenlehre*, Leipzig, 1938; Schmitz, DBM, ii, 33; E. E. Sikes, *Lucretius, Poet and Philosopher*, Cambridge, 1936, 58, 70 f., 91 f.; Susemihl, i, 87; Ueberweg, (1), i, 435; Windelband, (1), 162, 182; H. N. de Witt, *Epicurus and his Philosophy*, Minneapolis, 1954; Zeller, (1), III, i[4], 373 f., 409 f.

[6] C. Bailey, (2); E. Bignone, *Epicuro Opere, Frammenti, Testimonianze sulla sua Vita*, Bari, 1920; Usener, *Epicurea*, Leipzig, 1887.

[7] C. Bailey, (1), 438 f., 588; Ueberweg, (1), i, 453.

feared. Epikouros believed that we should mind our own business and let the gods mind theirs.[1]

As a philosophical theory independent of gods, Epikouros chose the atomic theory of Demokritos, which he elaborated into a serious and logical system.[2] Demokritos mistrusted the senses (see p. 46), but for Epikouros sense-perception is the only guarantee or criterion of truth.[3] All sensation is an atomic movement resulting from contact with material bodies, the simplest form being touch; in the other senses effluxes (απορροια) pass as a continual emission (ῥεῦσις) from the object to the sense organ. Sight depends on surfaces or idols (εἴδωλα) continually peeling off the surfaces of bodies, passing through space, and impinging on the eye.[4] If our senses were sharp enough we should see atoms, since these are real.[5]

Epikouros said[6] that 'to arrive at accurate knowledge of the cause of things of most moment is the business of natural science (φυσιολογία)'. Any hypothesis contradicting the senses must be rejected, and from this the atomic hypothesis followed logically[7] although he distrusted logic. He gave alternative explanations when possible, and Lucretius also did. Epikouros believed in nature acting by law yet without purpose, and differed from Demokritos by assuming free will, which is in the atoms themselves with their 'swerving'.[8] The soul atoms differ from fire, and the soul is perhaps a mixture of fire, air, spirit, and sensation (κρᾶμα ἐκ τεττάρων, ἐκ ποιοῦ πυρώδους, ἐκ ποιοῦ ἀερώδους, ἐκ ποιοῦ πνευματικοῦ, ἐκ τετάρτου τὶνος ἀκατονομάστου).[9]

The teachings of Epikouros (unlike those of the Stoics) were not much modified by his school, although some changes were made.[10] They gained a footing in Rome before 150 B.C.,[11] although the Romans did not esteem pure science.[12] It was mainly in the form of Lucretius's long didactic poem (7400 lines) *De Rerum Natura* that the atomic theory reached the Middle Ages;[13] Lucretius had taken his material literally from Epikouros,[14] he is an accurate source and need not be dealt with separately.

Lucretius

Titus Lucretius Carus (Rome; 100 to 94 B.C.–15 October 55 B.C.)[15] was a friend of C. Memmius, but practically nothing is known of his life. St.

[1] A. J. Festugière, *Epicure et ses Dieux*, 1948; tr. C. W. Chilton, *Epicurus and his Gods*, 1955.
[2] C. Bailey, (1), 1928, 531; *id.*, (4), 1910, 11.
[3] C. Bailey, (1), 237 ff., 529.
[4] Ep. i, Diog. Laert., x, 46–52; C. Bailey, (1), 242, 406 f.; Gilbert, 212; G. Murray, (1), 132.
[5] C. Bailey, (1), 263.
[6] Ep. i; Diog. Laert., x, 78.
[7] Ep. i, Diog. Laert., x, 50 f.; Benn, ii, 53 f.; C. Bailey, (1), 234, 237 f.; *id.*, (4), 13 f.
[8] Lucretius, ii, 216 f.; C. Bailey, (4), 15 f.
[9] Ueberweg, (1), i, 454.
[10] Deussen, (1), II, i, 433 f.; Ueberweg, (1), i, 446.
[11] Festugière, (1), 1949, ii, 261 (in its most flourishing period, 2 cent. A.D., it was confined to small circles in Greece and Rome); Merrill, *T. Lucreti Cari De Rerum Natura*, New York, 1907, 37 (Epicurianism, at first stoutly opposed, was well established in the time of Julius Caesar (102–44 B.C.) who, with most of his adherents, belonged to the school); Zeller, (1), III, i[4], 383.
[12] Cumont, (1), 1911, 6.
[13] Windelband, (1), 184.
[14] C. Bailey, (1), 11 (from the Μεγάλη Ἐπιτομή of Epikouros, according to Giussani); Gilbert, 222 f.; Kroll, ERE, ii, 199 (from later Epicureans); Mewaldt, PW, xiii, 1664, 1670 (title of RN a translation of περὶ φύσεως of Epikouros); Zeller, (1), III, i[4], 547.
[15] C. Bailey, (4), 8 (97–55 B.C.); *id.*, in OCD, 516; Mewaldt, PW, xiii, 1659; E. E. Sikes, 1936, 80; Ueberweg, (1), i, 436, 441, 444 (96 ?–55 B.C.).

Jerome[1] says he was poisoned by a love-philtre, became insane, and wrote his poem in his lucid intervals, and that it was revised by Cicero. Insanity is doubtful but Lucretius was mentally abnormal; a small revision by Cicero is possible.[2] Lucretius composed the poem about 57 B.C. It was unfinished but the existing books (except some lost lines) are complete. The style is earnest and sincere; very archaic words are used but otherwise the Latin is good. There are 9–10 cent. MSS. but at that time it was little known. A 9-cent. Leyden MS. came from Mainz, the see of Rabanus Maurus (A.D. 776–856), who mentions atoms.[3] It was first printed in 1473[4] and often later.[5] Lucretius[6] complains of the inadequacy of Latin to express 'the obscure discoveries of the Greeks'.

Physical Theory of Epikouros

The principal physical doctrines of Epikouros are as follows:

1. 'Nothing comes into being out of what is non-existent (μὴ ὄν)';[7] Lucretius[8] elaborates this: 'nothing is ever begotten out of nothing by divine power'; things are done 'without the hand of the gods', who do not interfere with the realised order of Nature; and he supports the assertion by arguments, e.g. everything requires a 'seed'.[9]

2. Nothing is ever annihilated, but all things on their dissolution go back into the first bodies;[10] Lucretius also supports this by arguments.

3. A void (κενόν, *inane*) exists, since if there were no void motion would be impossible, and the existence of bodies of different densities shows that 'void exists mixed up with the substance of bodies'. Space is 'an intangible existence (ἀναφὴς φῦσις)'.[11] Since the atoms are in ceaseless and rapid motion, any portion of void space may be momentarily occupied by a moving atom, like a fish swimming in water.[12] Both matter and space are infinite (as they were for

[1] *Addit. to Chron. Eusebii*, date 55 B.C. *Chronica Trivm Illvstrivm Avctorvm Evsebii Pamphili . . . D. Hieronymo interprete*, f°, Burdigalæ, 1604, 142.
[2] C. Bailey, (4), 9 f.; Benn, ii, 53 f.; Brandis, (1), III, ii, 439; Deussen, (1), II, i, 436; Gilbert, 205; Halévy, NBG, 1860, xxxii, 168; Lange, 97; Lippmann, *Mélanges Bidez*, 1934, ii, 585; *id.*, (3), 1953, ii, 50; J. Masson, (1), (2); W. A. Merrill. *University of California Publications in Classical Philology*, 1905, i, 111; 1909–14, ii, 35, 93, 227, 237, 255; 1916–18, iii, 1, 47, 135, 249, 265; 1917, iv, 1–258 (text of *De Rerum Natura*); Mewaldt. PW, xiii, 1659; Ramsay, DBM, ii, 828; E. E. Sikes, 30 f., 42, 88; d'Arcy Thompson, *Nature*, 1925, cxxi, 565; Ueberweg, (1), i, 445; J. Veitch, *Lucretius and the Atomic Theory*, 1875; Zeller, (1), III, i[4], 381, 400.
[3] *Opera*, ed. Pamelius, Cologne, 1626–7, i, 145; Langlois, *Origines et sources du Roman de la Rose*, 1891, 127; Lasswitz, (1), i, 30; Stones, *Isis*, 1928, x, 446.
[4] Klebs, 207.
[5] Ed. Thos Creech, Oxford, 1695; transl. *id.*, 2 vols., London, 1714 (with notes; both with good indexes); ed. Haverkamp, 4°, Leyden, 1725 (elaborate notes); ed. Wakefield, 4 vols., Glasgow, 1813; ed. H. A. J. Munro, with tr. and notes, 4 ed., 3 vols., 1905–10, and (giving variants) in Postgate, (1), i, 21–82; ed. C. Giussani, 4 vols., Turin, 1896–6–7–8 (a vol. of notes, 1900, not seen); ed. H. Diels, with tr., 2 vols., Berlin, 1923–4 (text arbitrarily altered and 'completed'); ed. Merrill, 1917 ed. J. Martin, Leipzig (Teubner), 1953; ed. and tr. C. Bailey, (3), (4); J. Paulson, *Index Lucretianus*, Gothenburg, 1911; summary in Mewaldt, PW, xiii, 1664–9. All text quotations here are from Bailey, (3), 1921.
[6] i, 136, 643.
[7] Epikouros, Ep. i, 38. [8] i, 150.
[9] C. Bailey, (1), 274; Deussen, (1), II, i, 439; Hicks, ed. of Diogenes Laertius, Loeb, 1925, 568 (a tenet common to all the pre-Socratics); J. Masson, (1), 8 f.; Zeller, (1), III, i[4], 413.
[10] Epikouros, Ep. i, 39; Lucretius, i, 215 f., ii, 670; C. Bailey, (1), 276; Masson, (1), 11 f.
[11] Epikouros, Ep. i, 40; ii, 86; Lucretius, i, 330 f., 370 f.; C. Bailey, (1), 278 f., 294 f.; Masson, (1), 12; Ueberweg, (1), i, 454 (only space is incorporeal).
[12] C. Bailey, (1), 296.

Demokritos), and nothing else exists.[1] If space were not infinite, all matter would have collected in a heap on the floor of finite space.[2] Epikouros taught that the number of worlds is infinite.[3]

Lucretius[4] was awed by the immensity of space; the swift bright thunderbolt, gliding in luminous race through infinite time, would fail to course through all space, or lessen in the slightest what still remains. There is no centre of the universe towards which all things tend.[5]

4. The sum of things always was such as it is now, and always will be; the universe is birthless, deathless and immutable.[6] The same idea is expressed by the Christian apologist, Minucius Felix (1–2 cent A.D.).[7]

5. The bodies of which compounds (συγκρίσεις, *concilia*) are formed are indivisible (ἄτομα), unalterable (ἀμετάβλητα), completely solid and compact (στερέον, πλήρη) corporeal existences (σωμάτων φύσεις), which are without void (ἀμέτοχα κενοῦ).[8] The name 'atom' is not used by Lucretius (as it is by Cicero[9] and Seneca);[10] he speaks of first beginnings,[11] bodies (*corpora*),[12] first bodies,[13] first principles (*elementa*),[14] seeds (*semina*),[15] seeds of things,[16] and shapes (*forma*).[17]

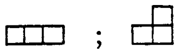
6. 'Primordial bodies are solid in their simplicity, and consist of the smallest parts closely united . . . from them nature allows nothing to be taken nor diminished, reserving them as seeds for things.'[18] Without void, nothing can be crushed, broken up by blows, or cut in two (nec findi in bina secando),[19] which exactly expresses the idea of the Greek ἄτομος. The atoms are impenetrable, indivisible, indestructible, strong in their solid singleness (solida pollentia simplicitate; æterna pollentia simplicitate; solida primordia simplicitate).[20] 'Though stricken by countless blows through eternity (plagis vexata per aevum)' they cannot be worn away; they are as fresh to-day as when the world was new.[21] The atoms are indivisible because they have no pores into which wedges may enter.[22] They have been exposed to fearful shocks of eternal combinations from atoms to things, and of dissolution of things to atoms, yet they form an adamantine wall against which death and decay beat in vain, an eternal barrier-line which reason sees beyond the phenomena of the changing world.[23]

7. Atoms differ in size (μέγεθος), shape (σχῆμα), and weight (βαρύ).[24] The number of sizes is not infinite; there is an upper limit, otherwise they would be

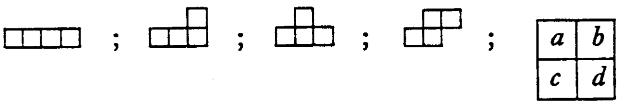
[1] Epikouros, Ep. i, 41–2; Lucretius, i, 420 f., 958 f., 988 f.; Atanassiévitch, 79; Masson, (1), 12.
[2] Lucretius, i, 989 f., 1074; C. Bailey, (1), 297 f.
[3] Atanassiévitch, 81.
[4] i, 1002 f.
[5] Lucretius, i, 1074; Masson, (1), 28 f.
[6] Lucretius, ii, 304 f. (with reasons); C. Bailey, (1), 277.
[7] *Octavius*, ed. J. Ouzel, Leyden, 1652, 39; *ib.*, 1672, 326.
[8] Epikouros, Ep. i, 40 f., 54 f.; Lucretius, i, 483 f., 551 f.; C. Bailey, (1), 281 f.; Masson, (1), 12 f.; Sikes, 72 f., 91 f.; Zeller, (1), III, i[4], 417.
[9] *Tusc. Disp.*, i, 25, 60; ii, 18, 45.
[10] *Quæst. Nat.*, ii, 6; v, 2.
[11] i, 483.
[12] i, 216, 483.
[13] i, 510.
[14] i, 827.
[15] i, 894.
[16] i, 614.
[17] ii, 336; for many other uses of these names see an index to Lucretius.
[18] i, 603.
[19] i, 530 f., 533; Masson, (1), 12 f.
[20] i, 574, 603, 609, 612.
[21] i, 583; Masson, (1), 13, 19.
[22] i, 530; Baeumker, 310.
[23] i, 540 f.; Hicks, 1910, 24, 256 (Epikouros assumed the atoms to be absolutely hard and therefore inelastic); Masson, (1), 20 f., 22.
[24] Ep. i, 54 f.; C. Bailey, (1), 284 f.

visible and a lower limit (for the existence of which Epikouros gives a subtle argument).[1] The least possible (ἐλάχιστα; *minimae partes*) parts of atoms are conceived only in thought and are always inseparable parts (πέρατα); their existence makes it possible to have different shapes with the same number of parts, i.e. size:[2]

2 parts: one shape only 

3 parts: two shapes 

4 parts: five shapes in one plane + 2 in two planes:



a on *b* or *c*
a on *d*

Lucretius seems to regard 3 parts (which cannot exist alone) as the minimum number.[3] This striking theory of 'smallest parts', although known to Gassendi,[4] was overlooked by many later writers. Epikouros says the number of shapes is limited, though atoms of any one shape are infinite in number;[5] atoms of the same shape differ in size and smoothness.[6] Changes are due to changes in the arrangement of atoms, sometimes through addition and subtraction of atoms.[7]

8. The atoms have weight (βαρύ).[8] Epikouros, in opposition to Aristotle, held that there is an *absolute* up and down in space; the direction from our feet to our head is always the opposite to that from our head to our feet;[9] antipodes are not recognised.

The atoms fall through space with great speed in straight lines by reason of their weight, and this motion, once begun, continues for ever. The atoms of various weights fall, each 'like a drop of rain', in a vacuum with equal speeds.[10] Atoms have weight because they are solid; their weight is proportional to their size, but difference of weight does not affect the 'natural downward motion'. The energy of the universe is wholly kinetic energy residing in the atoms,[11] and the sum of the 'motion' of all the atoms, like the sum of their matter, remains constant.[12]

9. Colour, smell, sound, cold, heat, etc., are not qualities of the atoms, since

[1] Ep. i, 55 f.; C. Bailey, (1), 285, 529; Hicks, 248; Zeller, III, i[4], 405.
[2] Atanassiévitch, 65 (ἐλάχιστα = *perpaucum*, as small as possible); C. Bailey, (1), 287.
[3] i, 599 f.; ii, 485 f.; Masson, (1), 14–15, 25.
[4] *Opera*, Lyons, 1658, i, 267.
[5] Ep. i, 43 f.; Gilbert, 208.
[6] Lucretius, ii, 335 f., 480 f., 522 f.; Masson, (1), 15.
[7] Epikouros, Ep. i, 54.
[8] Ep. i, 54; C. Bailey, (1), 289 f., 310 f., 529; *id.*, (2), 37, 216 f.
[9] Ep. i, 60 f.; Zeller, (1), III, i[4], 420; Deussen, (1), II, i, 440; Windelband, (1), 184 f.
[10] Ep. i, 43 f., 46; Lucretius, ii, 84, 160 f., 217, 225 f., 238; C. Bailey, (1), 129, 218, 289, 310 f. (thought the idea of weight of atoms was introduced by the teacher of Epikouros, Nausiphanes of Teos); Masson, (1), 40.
[11] Masson, (1), 36 f.
[12] Lucretius, ii, 294 f.

they can change, whilst atoms cannot change.[1] They are real, since the senses are infallible, and are due to changes of position and order of the atoms, or to addition or subtraction of atoms. Lucretius[2] adds that atoms are without sensation, even the soul atoms, and followed Demokritos in his theory of tastes as due to the shapes of the atoms (pleasant tastes corresponding with smooth and round atoms and harsh tastes with rough and hooked atoms),[3] but deviated from him in his explanation of colours; the atoms themselves are colourless and differences in colour of things are due, not only to the shapes of the atoms, as Demokritos said, but also to their arrangement.[4]

Qualities are either (i) inseparable properties (συμβεβηκότα) always accompanying things and having an existence (against Demokritos), although not material parts (μόρια) (as the Stoics thought); or else (ii) separable accidents (συμπτώματα).[5] Epikouros admitted more objectivity to sense-impressions than did Demokritos and regarded some qualities, particularly colour, as not simply existing 'by law (νόμῳ)'; he also distinguished properties due to atoms and collections of atoms.[6] The peacock's tail changes colour according to the direction of light falling on it, but remains the same body.[7] Epikouros differed from Demokritos in not regarding air as necessary for the propagation of sound, which consists of a current of particles (ἔκθλιψις ὄγκων τινῶν).[8]

10. Lucretius[9] speaks of atoms as 'hooked together (hamatis inter se)', but also[10] recognised 'rough' spherical atoms of salt in sea-water rolling among the water particles and not attached to them, although they may be more readily attached (magis haerescere possint) to particles of earth, filtration through which removes them. He has no idea of attractive *forces* between atoms.

11. The motion of atoms is fully treated by Epikouros in terms of: (α) free atoms, (β) the 'swerve', (γ) the 'blow', (δ) motion in compound bodies.[11]

(α) Free atoms always move downwards because of their weight (see § 8). (β) In perpendicular fall, atoms would never collide or catch one another (as the speeds are equal), and 'Nature would never have produced anything'.[12] Hence the famous theory of the 'swerve (*clinamen* in Lucretius)' is introduced. It is remarkable that this, the cardinal feature of the doctrine of Epikouros, is not mentioned by Diogenes Laertios; hence, he does not give the Greek name, which was perhaps παρέγκλισις (*parenklisis*).[13] Diogenes says a change of direction of motion of atoms is due to meeting with resistances[13a] or to collisions (εἰς τὸ πλάγιον),[14] but the 'swerve' for Epikouros meant a sudden change of direction in free motion and was not due to the influence of other bodies.[15]

[1] Ep. i, 54; Lucretius, ii, 730 f., 766 f., 806 f.
[2] ii, 865–990.
[3] ii, 398–407; sound, *ib.*, 410 f.; smell, *ib.*, 414 f.; C. Bailey, (1), 354.
[4] ii, 730–841; C. Bailey, (1), 354 f., 530.
[5] Epikouros, Ep. i, 68 f.; Lucretius, i, 451 f. (συμβεβηκός = *conjunctum*); C. Bailey, (1), 301 f., 353 f.; Hicks, 270 f.
[6] Baeumker, 314 f. [7] Lucretius, ii, 806 f.
[8] Ep. i, 52–3; C. Bailey, (1), 405. [9] ii, 80 f., 398 f. [10] ii, 467.
[11] Baeumker, 318 f.; C. Bailey, (1), 310 f.
[12] Lucretius, ii, 223; C. Bailey, (1), 316 f.; Masson, (1), 48 f., 124 f., 132.
[13] LSJ, 1332 (Epikouros, Fragm. 280). [13a] Ep. i, 47. [14] Ep. i. 61.
[15] Atanassiévitch, 68–70; C. Bailey, (1), 316 f.; (4), 287; Cudworth, iii, 116; Daubney, *Introduction to the Atomic Theory*, 2 ed., Oxford, 1850, 15; Hicks, 261; Masson, (1), 49; G. Murray, (1), 133, 142; Sikes, 75.

Lucretius says:[1] 'When atoms are borne straight downwards through the void by their own weights, at quite undetermined times and at undetermined spots, they push a little from their path, yet only just as much as you could call a change of trend (corpora cum deorsum rectum per inane feruntur, ponderibus propriis incerto tempore ferme incertisque locis spatio depellere paulum tantum quod momen mutatum dicere possis).' Also:[2] 'Wherefore, again and again, it must needs be that the first-bodies swerve a little; yet not more than the very least (quare etiam atque etiam, paulum inclinare necessest corpora; nec plus quam minimum)', and he speaks of 'exiguum clinamen'.

The theory of the swerve is called by Cicero[3] a 'puerile invention', and so, until the modern theory of wave-mechanics came into being, it seemed to many. It provided the means for Epikouros to introduce freedom of will and escape from destiny (εἱμαρμένη),[4] since mind (νοῦς) is an aggregate of very fine atoms, the 'swerve' of which constitutes deliberate will. The theory is an attempt to get over the determinism accepted by Demokritos, arising from a materialistic system.

Epikouros, while accepting the regularity of natural laws, gave some liberty to the final principles, the atoms. He introduced indeterminism into all branches of philosophy, moral as well as physical, and even into logic, since of two self-contradictory statements one need not *always* be true and the other false. This train of ideas is now more familiar in science than it was some years ago, when it could be called 'fundamentally monstrous'.[5] Lucretius uses the name 'natural law (et quid quæque queant per fœdera naturai)',[6] with the character of a compact. The word 'law (νόμος)' is not in Homer[7] and the 'ominous phrase "laws of nature"' is said to occur first in Plato.[8] Lactantius[9] mentions tricks of magicians as 'contrary to natural law (contra iura naturae)', so that the expression was not first introduced by Descartes.[10]

(γ) The blow (πληγή; *ictus, plagis*) resulting from a collision caused by swerving, deviates the motions of two atoms; they collide, and the process spreads. Atoms brought in contact may become attached, and by accretion around nuclei so formed, things are created.[11] The speeds of the atoms are not changed by collisions; they merely alter their directions.[12] A light atom trapped between two colliding heavy ones is driven upwards;[13] this is the reason why flames rise in air like wood in water, although 'their weights are fighting, as far as in them lies, to drag them downwards'.[14] Fire is composed of small particles; the particles of light or of the fire of lightning, are exceedingly small.[15]

Plutarch[16] and Simplikios[17] criticised Epikouros because the atoms can, by 'many and continual collisions produce only a confusion and combat of atoms, which they [the

[1] ii, 217–20. [2] ii, 243–4, 292; Deussen, (1), II, i, 441; Zeller, (1), III, i[4], 421.
[3] *De Fin.*, i, 6, 19; C. Bailey, (1), 317.
[4] Diogenes Laertios, x, 133 f.; C. Bailey, (1), 319 f.; Ueberweg, (2), i, 207.
[5] Kroll, ERE, ii, 199. [6] i, 586. [7] Scoon, 15.
[8] *Timaios*, 83e: φύσεως νόμους; A. E. Taylor, (3), 117. [9] *Instit.*, vii, 17.
[10] *Discourse on Method*, tr. G. B. Rawlings, 1902, 49; E. Zilsel, 'The genesis of the concept of natural law', in *Philos. Rev.*, 1942, li, 245; Mason, *Ann. Sci.*, 1953, ix, 64 (72).
[11] Masson, (1), 44 f.
[12] Epikouros, Ep. i, 61; not clearly stated by Lucretius; C. Bailey, (1), 329.
[13] Lucretius, ii, 184 f.; C. Bailey, (1), 328. [14] *Ib.*, ii, 203 f.
[15] *Ib.*, vi, 323 f.; Masson, (1), 14.
[16] *Adv. Colet.*, 10, *Opera*, ed. Deubner, Paris, 1841, ii, 1360; C. Bailey, (1), 347; Masson, (1), 44.
[17] *Comment. in Aristoteles De Coelo*, i, 10, 279, ed. Heiberg, Berlin, 1893, 295; C. Bailey, (1), 346; Masson, (1), 44.

Epicureans] choose to call generation'; collisions may produce entanglement and mechanical contact, but no fusion into one new nature.

Epikouros and Lucretius were clear that the atoms must group themselves in a certain way, forming what Lucretius calls a *concilium*, which is an important technical expression translating Epikouros's σύστημα (organism), and foreshadowing the doctrines of chemical combination among the atoms, and of the molecular composition of matter.[1] This aspect will now be considered.

(δ) The motion of the atoms is permanent and does not cease when they are contained inside bodies formed from them. This is a new development in the atomic theory.[2] The motion persists in collisions because atoms are elastic; they 'mutually give and receive motions'.[3]

When atoms clash, some kinds become locked in a close and strong bond of union, more hooked together (magis hamatis inter se) forming hard stones, iron, etc. Others 'leap back' but form a loose union in thin and fine substances such as liquids and air. Between these limits there are all varieties of closeness and looseness of texture, forming substances of corresponding degrees of density. Liquids are formed from smooth and round atoms, but a viscous liquid like oil may have its atoms larger or more hooked and entangled than those of wine.[4]

The three physical states, solid, liquid, and gas are so explained:[5] (*a*) when the atoms are at great distances and the texture is very loose, in air and fire; (*b*) when the atoms are closer but still require to be kept together by a shell (στεγάζον), in water; (*c*) when the atoms are closely interlocked in earth. The essentials for the formation of (*b*) and (*c*) are (α) entanglement (περιπλοκή), necessary for production (γένεσις), and (β) empty spaces or intervals (διαστήματα) between the atoms, necessary for decay (φθορά) or dissolution (διάλυσις, διάκρισις).[6]

12. The motions of atoms inside bodies, not perceptible to the eye because the atoms are so small, are still present. Lucretius[7] gives two striking analogies: (i) a flock of sheep when seen from a distance seems but 'a white spot standing on a green hill'; (ii) a mighty army of horse and foot in rapid motion, seen from a far mountain, seems but a small bright patch at rest on the plain. The state of 'feverish vibration (παλμός, *palmos*)' in a body apparently at rest acts as a retardation or 'check (ἀντικοπή)', due to the collisions of the atoms. The individual independent atom moves with its 'absolute' speed. When a few atoms join in a nucleus (ea quae parvo sunt corpora conciliatu) this motion is retarded by contrary motions inside it; the nucleus joins with others in a body whose pace is still slower, and so we reach a body large and slow enough to be perceptible, as the mote in the sunbeam.[8]

Epikouros may have assumed that in a body A moving from east to west there are, say, 24 atoms, but only 16 move from east to west, the other 8 moving in directions

[1] C. Bailey, (1), 293, 338, 347 f.; Masson, (1), 12, 27, 43 f., 45, 62.
[2] C. Bailey, (1), 330–58; *id.*, (2), 25, 37, 186 f., 201 f., 216 f., 220; Kroll, ERE, ii, 199.
[3] Lucretius, ii, 80 f., 405; Masson, (1), 36 f.
[4] Epikouros, Ep. i, 43; Lucretius, ii, 95–111, 444 f.; C. Bailey, (1), 331; Masson, (1), 15.
[5] C. Bailey, (1), 341; Hicks, ed. Diogenes Laertios, Loeb, 1925, ii, 573.
[6] Epikouros, Ep. i, 43–4; C. Bailey, (1), 345 f.
[7] ii, 314 f.; Masson, (1), 37 f.
[8] Epikouros, Ep. i, 61 f.; Lucretius, ii, 132–41; C. Bailey, (1), 333; (4), 69, 286.

more or less impeding. In a body B moving only half as fast as A, 8 atoms are moving from east to west and 16 in other directions.[1]

13. Epikouros's conception of a compound body (ἄθροισμα, *concilium*), as 'a new unity . . . which acquires new powers and faculties', is of great importance as a new development of the atomic theory.[2] The explanation of the combination of atoms in Lucretius's second book is only fragmentary, a long passage, it is supposed, having been lost before line 165, and curiously enough there is also a lacuna in Epikouros's own account.[3] This may, however, be presented as follows in his own words.

In the formation of compounds by collisions, 'some of them [atoms] separate to long distances from one another, while others again keep up vibration (παλμός, the traditional atomic word) whenever they chance to be checked by interlacing with others (περιπλοκή), or else shut in (στεγαζόμεναι) by atoms interlaced around them (παρὰ τῶν πλεκτικῶν).' Lucretius[4] is more detailed: 'some when they have dashed together, leap back at great space apart, others too are thrust but a short way from the blow. And all those which are driven together in more close-packed union and leap back but a little space apart, entangled by their own close-locking shapes, make the strong roots of rock, and the brute bulk of iron, and all other things of their kind. Of the rest[5] which wander through the great void, a few leap far apart, and recoil afar with great spaces between: these supply for us thin air and the bright light of the sun.'

The association into groupings (*concilia*) is due to some ordered or 'compatible' motion of all the atoms inside the complex. Lucretius[6] says atoms wandering in the void have been rejected from some unions (*concilia*) and not taken into others, nor have they been able 'to link on their movements (nec usquam consociare etiam motus potuere recepta)'.

The aggregation occurs continuously, atoms growing on small 'nuclei or clusters'.[7]

The 'minimum visible' is not, according to Bailey, a *discrete* stage in the process: 'the whole attempt at a parallelism between Epicurus' atomism and modern chemistry is . . . misleading and has done mischief.'[8] The names ὄγκος (*onkos*) and *cacumen* do not, according to Bailey, mean 'molecule', and the rare word *glomeramina*,[9] which Giussani says means 'molecule of liquids', means only 'round drops' in a stream of water, compared by Lucretius with the individual grains in a handful of poppy seed. The ὄγκοι are particles of matter of any size in any stage of atomic aggregation, and not molecules formed of determinate numbers of atoms.

Bailey[10] thinks that a trace of the technical meaning of 'molecule' is found in the notion of the 'seed (σπέρμα, *semen*)' as 'a nucleus of atoms of such shapes and relative arrangement that it is specially adapted for the creation of some particular thing'. It is the usual name in Lucretius for atoms; according to Masson[11] Epikouros does not use it in this sense, yet he uses σπέρματα (*spermata*) for the 'germs of coming into being',[12] and ὄγκοι for 'particles resembling the whole', or 'the least perceptible by sense', or the masses of 'the

[1] C. Bailey, (1), 335. [2] C. Bailey, (1), 337, 339 f.
[3] Ep. i, 43. [4] ii, 98–108.
[5] Text amended by Merrill, and by C. Bailey, (1), 340.
[6] ii, 109–11; cf. Epikouros, Ep. i, 47, 61, and note in C. Bailey, (1), 348 f.
[7] Lucretius, ii, 134 f.; C. Bailey, (1), 341 f.
[8] C. Bailey, (1), 286, 342–3, criticising Giussani, ed. Lucretius, Turin, 1896, i, 56 f., 577 f., and Masson, (1), 129.
[9] Lucretius, ii, 454; cf. iii, 497.
[10] (1), 343–4. [11] (1), 63. [12] Ep. i, 39, 41, 54.

least parts of the atom',[1] in the *separate* existence of which he did not believe. The name ὄγκοι occurs in Aristotle[2] in the sense of a small mass invisible to the senses, and was translated *moleculæ* by Gassendi (see Vol. II, p. 462) and Cudworth.[3] The use of the word by Asklepiades of Prusa is considered later (see p. 185).

14. Lucretius[4] says nothing apparent to sense is created out of atoms of a single kind (nil esse . . . quod genere ex uno consistat principiorum). The earth contains atoms of fire, e.g., which issue in volcanoes, and atoms of water, which issue as springs.

15. When collections of atoms are formed by collisions (συγκρίσεις), the heavy atoms sink down to form earth, and displace upwards the light atoms, forming fire and ether; like atoms tend to aggregate together to form definite bodies.[5] Epikouros rejected the vortex theory of Leukippos.[6]

'Not by design did the first beginnings of things place themselves each in their order with foreseeing mind, nor indeed did they make compact what movements each should start, but because many of them shifting in many ways throughout the world are harried and buffeted by blows from limitless time; by trying movements and unions of every kind, at last they fall into such dispositions as these, whereby our world of things is created and holds together, be it by chance or the force (*vi*) of nature.'[7]

16. 'It matters much with what others and in what position the atoms are held together (atque eadem magni refert primordia sæpe, cum quibus et quali postura contineantur).'[8]

17. Epikouros describes meteorological phenomena in some detail.[9] Lucretius[10] says 'the air is changed over its whole body every hour in countless ways' by receiving particles from things and also giving them back — since otherwise things would have been dissolved into air. A world (i.e. a system composed of an earth, heaven and heavenly bodies) is surrounded by an outer wall of ether studded with stars, which are fires fed by its substance. This outer wall Lucretius calls 'the flaming walls of the world (flammantia mœnia mundi)', a fiery bastion guarding the earth and walling it in from the infinite outer sea of space interspersed with infinite atomic dust.[11]

The world is growing old;[12] a chance-made world cannot be permanent, since chance will separate again the atoms it brought together. Things decay by loss of their atoms, but these constitute a new form, and hence there is a ceaseless cycle of life and death: the sum of things is ever being replenished.[13]

By the constant battering of the atoms even the walls of the wide world all round will be stormed and fall into decay and crumbling ruin;[14] the earth had become tired and was losing its fertility[15] — really a result of the withdrawal of

[1] Ep. i, 52, 54, 56–7; C. Bailey, (1), 577–8.
[2] *Phys.*, i, 4, 187*a*: διὰ δὲ μικρότητα τῶν ὄγκων, propter molis parvitatem.
[3] i, 65 f. [4] ii, 583 f.
[5] Lucretius, v, 416 f.; Gilbert, 210, 215 f.; Zeller, (1), III, i[4], 423. [6] Ep., ii, 90.
[7] Lucretius, i, 1021 f.; v, 416 f.; vi, 31; C. Bailey, (1), 141; (4), 200; Cudworth, i, 138.
[8] Lucretius, i, 817; a remarkable anticipation of modern views on chemical constitution, including isomerism.
[9] Ep., ii, 99 f. [10] v, 275 f.
[11] Epikouros, Ep. ii, 88; Lucretius, i, 73; C. Bailey, (1), 359 f.; Masson, (1), 70, 72.
[12] Lucretius, ii, 1160 f.; Masson, (1), 32 f.
[13] Lucretius, ii, 67 f. [14] *Ib.*, ii. 1148; v, 364 f. [15] *Ib.*, ii, 1157 f.

labour for the ceaseless wars. 'The gate of death is not shut on sky or sun or earth or the deep waters of the sea, but it stands open facing them with huge vast gaping maw'.[1]

18. The earth first produced plants and trees, which were not regarded as living things (ἔμψυχα), their growth being mechanical and not vital.[2] Then animals and living things and finally men sprang from 'wombs' in the ground.[3] The human body consists of water and earth.[4] Life arose spontaneously as a mode of motion of dead matter; it is a prejudice to think that life can come only from life. To produce living things (as distinguished from dead) the atoms need only be very small, of spherical figures, like poppy seeds, and fall into special arrangements and mutual motions.[5]

19. Lucretius[6] distinguished radiant heat, coming with immense speed from the sun along with light, from common heat, slowly struggling through the entangled mass of matter.[7] The fire atoms in a body cause a separation of its parts.[8] In the freezing of water the spherical fire atoms are expelled and the triangular (tetrahedral ?) atoms of water (or cold ?)[9] are compressed; there is an accretion from without, of such atoms which being driven together cause the water to solidify. Wine contains two kinds of atoms, one warming, the other cooling; when it turns into vinegar, the warming atoms escape.[10]

20. Lucretius[11] has a long section on the attraction of the magnet (lapis quem magneta vocant); it is due to a subtle emanation passing through the pores of the magnet; the particles of this effluence (*æstus*) beat away the air and make a vacuum, into which the closely linked (connexa) atoms of iron rush, thus drawing the whole iron ring with them. The air inside the iron and that behind the ring also push it forward.

21. The soul (ψυχή) is material, consisting of smooth, round, very minute atoms, much smaller than those of fire, and spaced out at great intervals in the body.[12] The soul leaves the body on death, its atoms are completely dissipated in space, and there is no life after death.[13] Pneuma, an indefinite 'fourth substance (*quarta natura*)', is the vehicle of feeling.[14] Mind is a subtle texture of fine and pure soul atoms, the swerving of which is an act of will.[15]

Masson[16] says Lucretius taught that 'the human will is free in a universe otherwise determined by unbending laws'; although formed by chance aggregation of atoms, there is in it a definite causality working out the regular cycles of events: 'things have

[1] *Ib.*, v, 373 f.
[2] Lucretius, v, 772 f.; C. Bailey, (1), 377; Zeller, (1), 1880, III, i, 415 f.
[3] Lucretius, v, 791 f.
[4] Gilbert, 219.
[5] Lucretius, iii, 178 f. (principio esse aio persubtilem atque minutis); Masson, (1), 73 f., 109.
[6] iv, 183 f.
[7] *Ib.*, ii, 150 f.
[8] C. Bailey, (1), 397; Gilbert, 218; Plato, *Tim.*, 61E; ed. Martin, 1841, i, 164.
[9] Epikouros, Ep. ii, 109.
[10] Gilbert, 213, 291, 307; Immisch, *A. Rel.*, 1911, xiv, 449.
[11] vi, 906–1089.
[12] Epikouros, Ep. i, 66; Lucretius, iii, 177 f., 376 f.; C. Bailey, (1), 385, 588 f.; Masson, (1), 112 f.; Zeller, (1), 1880, III, i, 417–20.
[13] Epikouros, Ep. i, 65; Lucretius, iii, 403 f., 830 f.; C. Bailey, (1), 400 f.; Zeller, (1), III, i^3, 432–5.
[14] Epikouros, Ep. i, 63; Lucretius, iii, 128, 231; C. Bailey, (1), 387, 580; Gilbert, 217; Kroll, ERE, ii, 199; Sikes, 1936, 105 (spirit = mind); Windelband, (1), 188; Zeller, (1), III, i^3, 433.
[15] Lucretius, ii, 251; iii, 161; C. Bailey, (1), 320, 402, 433.
[16] (2), 1909, ii, 94.

thus happened from the first rise of the world, one after the other they come round even now in definite fixed order'; everything which has ever happened will happen again in the same way.[1]

The mobile soul atoms cause sensation, fire atoms produce warmth, air atoms rest, and pneuma motion.[2] The eye perceives by thin layers of atoms, idols or images (εἴδωλα, *simulacra*), yet the body from which they emanate does not seem to waste, because the atoms are so small; these images may pass through other bodies.[3]

Hermarchos of Mitylene, who succeeded Epikouros as head of the school, is credited with a searching criticism of the philosophy of Empedokles, especially its mystical tendency.[4] Metrodoros of Lampsakos, called by Cicero 'the second Epikouros', died seven years before his master. Kolotes, another disciple, is known from Plutarch's criticism. Zeno of Sidon (*c.* 150 B.C.), Phaidros (*c.* 100 B.C.), Philodemos of Gadara (Cicero's time), and Apollodoros (*c.* 100 or 95 B.C., head of the school) are other names.[5]

The atomic theory was criticised unfavourably by Cicero[6] and Seneca.[7] Seneca rejects Demokritos's theory (in multo inani pauca sunt corpuscula), but speaks of corpuscles rising from the earth; he regarded air as continuous, without vacuous spaces. The criticism of the atomic theory by Galen (A.D. 130–199) is weak but important, since he was one source for the Middle Ages. He attacks Leukippos, Demokritos, and Epikouros, with whom he groups Anaxagoras, Empedokles, and Asklepiades. His chief arguments[8] are that (i) man must consist of more than one element, and (ii) that atoms are supposed to have no feeling; even if each atom had feeling, two or more could not feel pain when they are separated.

[1] Lucretius, v, 677 f.
[2] C. Bailey, (1), 390, 580 f.; Zeller, (1), III, i[4], 432.
[3] Epikouros, Ep. i, 46–50; Lucretius, iv, 26–216; C. Bailey, (1), 407; Masson, (1), 17, 46 f.
[4] Zeller, (2), 1931, 231; von Arnim, PW, viii, 721.
[5] Deussen, (1), II, i, 433.
[6] *De Finibus*, bk. i; *De Nat. Deorum*, bk. i.
[7] *Quaest Nat.*, ii, 2, 6–7; v, 2–5; *De Benefic.*, iv, 19.
[8] *Opera*, ed. Kühn, Leipzig, 1821, i, 422; Summary in Lasswitz, (1), i, 230 f.

CHAPTER VII

THE STOICS

The conquests and policy of Alexander the Great (356–323 B.C.) broke down the barrier between Greeks and 'barbarians' and opened a new epoch, the so-called Hellenistic Period.[1] Greek thought and language penetrated the Roman empire. Greek philosophy incorporated some ill-defined Eastern elements, and Greek (in a simplified form) was the common language (*κοινή*) of the Hellenistic world. There was also a fusion of religions. Some of the greatest names in ancient science belong to this period, which made notable contributions to art, literature, and philosophy.[2]

From about 300 B.C. there were four well-established philosophical schools in Athens: the Academic (Plato's), Peripatetic (Aristotle's), Epicurean, and Stoic. Interchange of ideas led to the founding of the kindred movements of Scepticism and Eclecticism.[3]

The Sceptical School (also called the Middle and New Academy), founded by Arkesilaos (315–241/0 B.C.), opposed the Stoics. Its teachings, based on the axiom that nothing certain can be known, are given by Sextus Empiricus (*c.* A.D. 175).[4] Eclecticism (or Syncretism) (later 2 cent. B.C.), in essence sceptical, gave rise to another Sceptical school, which persisted until A.D. 300. These schools neglected science. The post-Aristotelian schools tended to divide philosophy into ethics, physics, and logic, with special emphasis on the first.[5]

The name Stoic, or 'school of the porch', is derived from the *Στόα ποικίλη*, a portico in Athens adorned with paintings by Polygnotos where the school first met under Zeno about 300 B.C. They were first called 'Zenonians'. Only fragments of early Stoic writings have survived and connected works belong to the Roman period.[6]

[1] The name 'Hellenistic' was used by Salmasius, *Funus Lingua Hellenistica*, Leyden, 1643, but was popularised by Droysen (*Geschichte des Hellenismus*); it has been defined as 'das kosmopolitisch mitteilbar gewordene Griechentum': Burckhardt, (1), 117.

[2] Droysen; Kaerst; Mahaffy, (1); *id.*, (2); Rostovtzeff, (1), 356–95; *id.*, (2); Tarn, (1); *id.*, (2); Wendland.

[3] Inge, (1), 1918, i, 79.

[4] *Opera*, ed. J. A. Fabricius, f°, Leipzig, 1718; Bevan, (1); Deussen, (1), II, i, 449; W. Heintz, *Studien über Sextus Empiricus*, Halle, 1932; M. M. Patrick, *The Greek Sceptics*, New York, 1929; Windelband, (1), 202; Zeller, (1), III, i^4, 49.

[5] Windelband, (1), 156, 170, 178; Zeller, (1), III, i^4, 14, 18.

[6] Joannes ab Arnim, *Stoicorum Veterum Fragmentum*, 3 vols., Leipzig, 1905, i (Zeno); 1903, ii (Chrysippos); 1903, iii, (Chrysippos); Index, 1924 (summary in Barth); E. V. Arnold; Baeumker, 326–70; Barth; Bevan, (1); Brandis, (1), III, ii, 55; *id.*, in DBM, iii, 1313; E. Bréhier, *Chrysippe*, Paris, 1910; W. L. Davidson, *The Stoic Creed*, Edinburgh, 1907; Deussen, (1), II, i, 394–429; Gilbert, 225–52, 266–71, 292, 391; F. F. M. Heinze; Hicks; J. Kroll, (1); H. Meyer,

The Stoics are divided into Older (Zeno, Kleanthes, and Chrysippos), Middle (Panaitios, Boëthos, and Poseidonios), and Younger (the Roman school, Seneca, Epiktetos, Cicero, Marcus Aurelius). Zeno (*Ζήνων*), an Oriental Greek of Kition (Citium) in Cyprus, was a student in the Academy. It is not certain that he was a Phoenician.[1] His dates are variously given, perhaps 333/2–261/0 B.C.[2] Kleanthes of Assos in Troas, 331–251 (or 232) B.C., was originally a pugilist, later a baker.[3] Chrysippos of Soli in Cilicia (or of Tarsus), *c.* 280–207/6 B.C., the 'second founder', systematised earlier teachings and introduced new features; he was very influential; 'without Chrysippos no Stoa', it was said.[4] Panaitios of Rhodes, 185–110 B.C., accompanied Scipio Africanus to Alexandria and taught Stoicism to the Romans (his book was used by Cicero), although a decree of the Senate in 150 B.C. banished 'foreign' philosophers from Rome.[5] Boëthos of Sidon (2 cent. B.C.) introduced Aristotelian elements and taught that the soul is composed of air and fire.[6] Poseidonios of Apamea in Syria, 135–51 or 139–60 B.C., was eclectic,[7] as was Seneca of Cordova (see p. 166) (5 B.C.–A.D. 65). Epiktetos of Hierapolis in Phrygia (A.D. *c.* 35–135) was an ethical teacher.[8] Stoicism as a living system ended with the Emperor Marcus Aurelius (A.D. 120–80).[9] It has influenced St. Paul, Tertullian, St. Augustine, Boëthius, and medieval and modern philosophy.[10]

Stoic philosophy and religion were cosmopolitan; Zeno drew no class distinctions.[11] The Stoics had the idea of a common law (*κοινὸς νόμος*) based on the law of nature.[12]

The Oriental origin of the founders of Stoicism is seen,[13] but the main foundations are Greek, especially Herakleitos, perhaps through Plato, Aristotle, and the later Peripatetics;[14] they perhaps drew upon Orphicism and

Geschichte der Lehre von den Keimkräften, Bonn, 1914; Nestle, (2), ii, 1 f.; A. C. Pearson, *The Fragments of Zeno and Cleanthes*, 1891; M. Pohlenz, *Die Stoa, Geschichte einer geistigen Bewegung*, 2 vols., Göttingen, 1948–9 (2 ed., vol. ii, 1955); Reinhardt, (1); *id.*, (2); *id.*, PW, 1953, xliii, 558–826; Robin, 345 f.; Sambursky, (1); *id.*, (2); Schmekel, *Die Philosophie der mittleren Stoa*, 1892; H. Siebeck, *Geschichte der Psychologie*, Gotha, 1884, I, i, 130 (*pneuma*); H. and M. Simon, *Die alte Stoa und ihr Naturbegriff*, 1956; Susemihl, i, 48 f.; ii, 62 f.; Ueberweg, (1), i, 410 f., 475, 486; Verbeke, 172–4; Zeller, (1), III, i[4], 50, 118 f. Diogenes Laertios (Bk. vii, §§ 1–200) and Cicero (*De Natura Deorum* and *De Divinatione* give accounts of Stoic physics.

[1] Festugière, (1), ii, 266; Zeno of Tarsus is a different person, Zeller, (1), III, i[4], 45; Susemihl, i, 49; Tarn, (1), 295; Zeller, (1), III, i[4], 29.

[2] W. S. Ferguson, *Hellenistic Athens*, 1911, 185; Festugière, (1), ii, 265; other dates in Pearson, 1; Ueberweg, (1), i, 410; Verbeke, 15.

[3] Pearson, 1; Verbeke, 41; Zeller, (1), III, i[4], 36.

[4] Arnold, 91 f.; Barth, 52–116; Bréhier; Verbeke, 62; Zeller, (1), III, i[4], 40.

[5] Arnold, 101; Barth, 127; Deussen, (1), II, i, 400; Schmekel, 2, 185; Susemihl, ii, 63; Ueberweg, (2), i, 189; Zeller, (1), III, i[4], 577.

[6] J. Kroll, (1), 267; Zeller, (1), III, i[4], 573, 624.

[7] Arnold, 105; Barth, 139; Deussen, (1), II, i, 401; Susemihl, ii, 128; Verbeke, 110–41; Zeller, (1), III, i[4], 592.

[8] A. Bonhöffer, *Epiktet und die Stoa, Untersuchungen zur Stoischen Philosophie*, Stuttgart, 1890; *id.*, *Die Ethik des Stoikers Epiktet*, Stuttgart, 1894; *id.*, *Epiktet und das Neue Testament*, RVV, Giessen, 1911, x.

[9] Renan, (1), 1882, vii.

[10] Barth, 268, 273, 296, 302, 308 f.

[11] Arnold, 216 f., 271, 297; Droysen, III, i, 17; Festugière, (1), ii, 176 (perhaps the policy of Alexander the Great); Zeller, III, i[4], 306.

[12] T. R. Glover, (1), 80; Windelband, (1), 195.

[13] Anrich, 36; Dill, (1), 289–383; Kennedy, 14, 20 f.

[14] Arnold, 17, 41 f., 70; Deussen, (1), II, i, 391; Gilbert, 225, 266; Heinze, 169; Mahaffy, (1), 485; Pearson, 50; Verbeke, 48; Zeller, (1), III, i[4], 126, 364, 367.

Greek traditions, as well as philosophy.[1] Zeno may have been under Babylonian influence, perhaps through Berossos (fl. *c.* 290 B.C.),[2] or under Persian influence,[3] and he believed in astrology,[4] but the Eastern elements[5] have perhaps been over-emphasised.[6] Tatian (*c.* A.D. 165) proclaimed the debt of the Greeks to the 'barbarians'.[7]

The aim of Stoicism was largely practical; the actual truth of natural phenomena could perhaps never be attained; this culminated with the Sceptics (see p. 149), and turned attention away from physics. The dominating principle was materialism, tempered with belief in astrology, and some occultism.[8] The Stoics were fond of allegories, false etymologies (e.g. *πᾶν*=*Πάν*, *χρόνος* =*Κρόνος*), the physical interpretation of myths, religion, and popular superstitions, and their speculations on *νοῦς*, *λόγος*, *σοφία*, etc., later entered Neoplatonism and Gnosticism. Perhaps the identification *κρόνος*=*χρόνος* (time) was derived from the old Semitic identification of Kronos (Saturn) and Zurvān-Bēl (the god of Infinite Time), which lasted till the time of Moses of Khoren (d. *c.* A.D. 488).[9]

The Stoics tended to regard everything as material, but did not, like Plato and Aristotle, draw a sharp line between matter and 'spirit'. Everything was a unity, matter or body, and force or spirit, being inseparably joined,[10] but they recognised that empty space, place, times, and thought (*λεκτόν*) are not bodies.[11] They opposed atomism; Kleanthes wrote on atoms against Epikouros.[12] Their picture of the universe as permeated by jets of 'pneuma' or divine energy, identified with actual or potential heat, approached the modern doctrine of energy, and they had the idea of the indestructibility of energy.[13] The Epicurean and Stoic philosophies were much nearer to the modern scientific attitude than those of Plato and Aristotle.[14]

Stoicism appealed to the Romans because (i) it did not (like Platonism) require long years of study, (Loukian (*c.* A.D. 150) said that it took twenty years to learn one system of philosophy adequately)[15]; (ii) its physics and theology were relatively simple; (iii) its physics was penetrated by religion, (iv) it presented a theory of government;[16] and, it may be added, (v) because it was addressed to normal intelligent people, not to a select group.

[1] Dieterich, (1), 84.
[2] W. Scott, ii, 126.
[3] Arnold, 17.
[4] Tarn, (1), 296, 312.
[5] Bouché Leclerc, (1), 68; Cumont, (2), 82; Gressmann, *Beih. a. O.*, 1926, v, 13; Windelband, (1), 163; Zeller, (1), III, i[4], 27; III, ii[4], 263.
[6] Festugière, (1), ii, 266; Robin, 341; Verbeke, 54; Whittaker, (1), 12.
[7] Deussen, (1), II, ii, 306; Renan, (1), vii, 104.
[8] Arnim, ii, 331 f.; Arnold, 18, 155; Deussen, (1), II, i, 401 f., 414, 449 f.; Ueberweg, (2), i, 194; Windelband, (1), 180 f., 202; Zeller, (1), III, i[4], 14, 18, 119.
[9] Arnim, ii, 318; Bousset, (1), 45, 139; Dieterich, (1), 77, 83; Gilbert, 251; Kennedy, 4; Mayer, Ro., ii, 1452, 1495; Reinhardt, (2), 281; Reitzenstein, (5), 177; Zeller, (1), III, i[4], 330 f., 343.
[10] Arnold, 18, 157, 172, 241; Heinze, 79 f., 92; Zeller, (1), III, i[4], 182 f.
[11] Arnold, 19, 98, 157 f.; Brandis, (1), III, ii, 62; Tarn, (1), 293 f.; Windelband, (1), 180 f. Zeller, (2), 215.
[12] Pearson, 47; Sambursky, (2), 44.
[13] Pearson, 99.
[14] Partington, *Ann. Sci.*, 1948, vi, 102; Pearson, 23–4.
[15] *Hermotimus*, 48; (1), ii, 68.
[16] Festugière, (1), ii, 440.

Stoic Physics

The Stoics first identified the primary matter (ὑποκείμενον, οὐσία) with Aristotle's ὕλη or substrate devoid of properties or form (σῶμα αποιον καὶ ἄμορφον; ἄποιος οὐσία), what was called (e.g. by Diogenes Laertios), 'first matter (πρωτη ὕλη, or πρωτίστη ὕλη)', but not matter without form and qualities. The ὕλη never exists as such; it was all used up in forming the elements (στοιχεῖα, also called ὕλη).[1] The properties (ποιότητες) characterising separate things, united with the primary matter (ὕλη), correspond with Aristotle's 'form (εἶδος)', but are material, a breath or current of air or pneuma (πνεῦμα, later *spiritus*), penetrating and mixing with the ὕλη and, in living things, the principle of growth (φύσις). Several properties can mix in the same substance and hence material bodies can interpenetrate.[2] Chrysippos distinguished four kinds of beings: inorganic, organic, those with life (ψυχή), and those with intelligence (νοῦς).[3]

The four elements are formed from ὕλη by the divine creative 'reason' or 'word' (λόγος, see p. 151), an idea taken ultimately from Herakleitos (see p. 10) but modified by Aristotle's teleology. It is a 'seed power (λόγος σπερματικός)' in the universe, causing it to develop, as plants and animals grow from seed (σπέρμα). The creative logos is in a state of tension (τόνος, *tonos*; Latin *intentio*; tone, tension, strain, also called *logos*), introduced by Kleanthes as a 'blow' or force imparted by fire, whilst Chrysippos regarded it as an equilibrium between two opposite forces, in line with the teaching of Herakleitos (see p. 11).[4] Philo Judæus identified it with the 'world soul'[5], so initiating the theological use of the word, and the tonos was later regarded as a property of pneuma (πνεῦμα).[6]

Matter has in itself the principle or power of movement, and the Stoics agreed with Anaxagoras (p. 22) that this is alternate rarefaction and condensation, a 'wave' moving in opposite directions.[7] Tonos was at first muscular activity then tone of spirit (πνευματικὸς τόνος), explaining the operations of both body and mind.[8] The tonos or elasticity of the pneuma urges its creative force centrifugally outwards; in walking towards the feet.[9] The fiery breath (πνεῦμα ἔνθερμον καὶ διάπυρον) is the essence (οὐσία) of the soul (ψυχή), filling it with tonos and binding it to the body as pneuma.[10] There is a stretching motion (τονικὴ κίνησις; πνεῦμα κινούμενον) in bodies which moves simultaneously inwards, giving rise to unity and substance, and outwards, giving rise to quantities and qualities (τονικήν τινα εἶναι κίνησιν περὶ τὰ σώματα

[1] Arnim, i, 24; ii, 111, 115–16, 136; Arnold, 157, 165; Baeumker, 330; Heinze, 92, 118; Pearson, 96; Zeller, (1), III, i^4, 104.

[2] Arnold, 168–9, 177, 188; Bréhier, 119, 124; Deussen, (1), II, i, 414; Gilbert, 251; Zeller, (1), III, i^4, 101.

[3] Barth, 78; Zeller, (1), III, i^4, 196.

[4] Arnim, ii, 310; Arnold, 160; Barth, 48–9, 72; Verbeke, 71; Zeller, III, i^4, 120 f.

[5] Arnim, ii, 147 f.

[6] Arnim, ii, 144 f.; Baeumker, 342, 350; Gilbert, 268; Pearson, 42; Samburksy, (1), 133, 203; Zeller, (1), III, i^4, 120, 133.

[7] Arnold, 158.

[8] Arnold, 160; Heinze, 93 f.; Sambursky, (2), 30.

[9] Arnold, 89.

[10] Arnim, i, 38; ii, 145, 217, 228, 258; Deussen, (1), II, i, 415; Gilbert, 237, 243, 268.

εἰς τὸ εἴσω ἅμα κινουμένην μεγεθῶν καὶ ποιοτήτων ἀποτελεστικὴν εἶναι, τὴν δὲ εἰς τὸ ἔσω ἑνώσεως καὶ οὐσίας, ἐρωτητέον αὐτούς). Philo Judæus said pneuma produced a strong bond in stone and wood by returning upon itself (*ἀναστρέφον ἐφ' ἑαυτό*), beginning in the centre, spreading to the edges, and then returning to the starting place. Philo said even the (immaterial) *λόγος* of the Creator did not move by change of place (*οὐ μεταβατικῶς κινούμενος*) but by a tensional (tonic) motion (*τονικῇ χρώμενος τῇ κινήσει*).[1]

The Stoics had some idea of a repulsion of particles (*ἄποιος ὕλη*), like that assumed in the later caloric theory of heat, as well as attraction.[2] Fire is one of the four elements but has a primacy among them, corresponding with its divine nature and its position above the others in the universe; the other elements also have some proportion of fire.[3] Besides common culinary destructive fire (*πῦρ ἄτεχνον*) there is a constructive, intellectual, life-giving and growth-promoting fire (*ζωηφόρον πῦρ; πῦρ νοερόν πῦρ τεχνικόν*),[4] named divine essence (*οὐσία θεοῦ*), material of the stars, divine breath, pneuma, cosmic reason (*κοινὸς λόγος*), Zeus, etc., an active principle (*τό δραστήριον*), as a compound of the light and active elements, fire and air.[5] 'Nature is an artistically working fire, going on its way to create; which is equivalent to a fiery, creative, or fashioning breath (*πνεῦμα*).'[6] 'Nothing lives without heat.'[7] The formative fire is diffused through the universe and even the coldest body has some of it, since very cold water can become colder ice. Kleanthes regarded fire as the active principle of the world, since it is the only one of the elements with an innate motion; he thought that solids become liquids and liquids become vapours by taking up heat.[8]

In place of the four causes (*αἰτία*) of Aristotle (p. 85) the Stoics had only one, the creative word (*λόγος*), which is an aspect of the primal creative fire.[9] In place of Aristotle's ten they had four main categories: substance (*ὑποκείμενον*), quality (*ποιόν*), disposition (*πώς ἔχον*, e.g. lying down or standing), and relative state (*πρός τί πως ἔχον*, e.g. right-left, son-father).[10]

The qualities are material, a kind of breath (*πνεῦμα*) animated with tension (*τόνος*, *tenor*), 'spirits with air-like tensions', keeping a thing together,[11] and inseparable from matter, like the *συμβεβηκότα* (*conjuncta*) of Epikouros. A body is completely penetrated by its qualities as a complete mixt (*κρᾶσις δι' ὅλων*) or total co-penetration; not a juxtaposition or mechanical mixture (*παράθεσις*) like different kinds of corn in a bin, nor an ordinary mixture (*κρᾶσις*) as of dry things like iron with fire, or (*μῖξις*) as of moist things such as water with wine, nor yet a chemical combination or fusion (*σύγχυσις*) as

[1] Arnim, ii, 145–6, 148–9; Sambursky, (2), 139, thought stationary waves in an elastic medium were implied.
[2] Zeller, (1), III, i[4], 133–7, from Simplikios, *In Cat.* 67e, ed. Kalbfleisch, 1907, 264. 33.
[3] Arnold, 181.
[4] Arnim, i, 34 (Zeno), 111 (Kleanthes); ii, 139 (Chrysippos); Arnold, 17; Gilbert, 239, 243.
[5] Arnim, i, 34; ii, 307; Arnold, 17, 161, 180; Cicero, *De Nat. Deor.*, ii, 15; Deussen, (1), II, i, 415; Gilbert, 239, 243, 251; Windelband, (1), 180, 186; Zeller, (1), III, i[4], 141.
[6] Diogenes Laertios, vii, 156.
[7] Seneca, *Quaest. Nat.*, II, x, 1.
[8] Cicero, *De Nat. Deor.*, ii, 9–10; Arnold, 181.
[9] Arnold, 162–3.
[10] Arnim, ii, 124 f.; Sambursky, (2), 17.
[11] Arnold, 166 (compares with caloric as an imponderable fluid); Bréhier, 123; Deussen, (1), II, i, 414; Gilbert, 268, 271; Heinze, 93.

when drugs on mixing lose their qualities; it is a state in which the components mutually penetrate one another but still preserve their individuality and substance (οὐσία). Their specific qualities are in the mixture as the soul is in the body. This doctrine, peculiar to the Stoics, probably originated with Zeno but was more particularly developed by Chrysippos.[1] Chrysippos compared the diffusion of *pneuma* through the cosmos with the diffusion of wine through water,[2] and he may have experimented on diffusion and osmosis with wine and water.[3] Empedokles[4] said wine mixes with water but not with oil: 'only the porous and the dense will mix.'

'A small drop of wine thrown into the sea will be equally diffused over the whole sea for a while, and then will be blended (συμφθαρήσεται) with it.'[5] Alexander Aphrodisias said the combination can be resolved again, as a sponge soaked in oil can take up water from a mixture of water and wine and leave the wine, the sponge being derived from water and so attracting it, whilst the wine, of a different nature, is left behind.[6]

The sum of all mixtures, the whole (ὅλον), is the world order or universe (κόσμος), an idea which Arnold thought was of Babylonian origin. The Stoics distinguished between the totality of everything which is (πᾶν), and the world (ὅλον) composed of the four elements.[7] The name κρᾶσις was also used for each of the four human 'temperaments', fervid, frigid, dry and moist, according to the preponderance of fire, air, earth, and water, respectively; dull natures have excess of earth and water, timid excess of cold air, passionate excess of fire.[8] The 'correct' (literally 'good') mixture (εὐκρασία, *eukrasia*) of the elements gives rise to health of body or soul.[9]

The κρᾶσις δι' ὅλων (*universa fusio*), or σῶμα διὰ σώματος χωρεῖ, described the union of soul with body, quality with substance, light with air, god with the universe, and in such states 'body moves through body', there being no void in the universe (κόσμος), which is a whole (ὅλον). Outside the universe there is a void, which is incorporeal. To preserve their monism the Stoics included bodily and incorporeal in a higher class, which they called 'the existent (τό ὄν, *quod est*)' or 'quiddity (τινά, *quid*)'.[10]

The Elements

Elements (στοιχεῖα), as contrasted with principles (ἀρχάι), can be created or destroyed, and changed into one another by an upward and downward path (ἄνω καὶ κάτω), as Herakleitos had taught. Zeno postulated two principles (ἀρχάι), active λόγος and passive matter (ὕλη), but one cannot exist without the other. All bodies contain the four elementary qualities, heat, cold, wet, and dry, and the four elementary bodies. Fire (πῦρ) was first formed from ὕλη and divine heat. Chrysippos divided the four elements into two active (δραστικά, ποιητικά, ποιοῦν), fire and air, and two passive (παθητικά, πάσχον), water and

[1] Arnim, ii, 152–3; Arnold, 169–76; Gilbert, 233, 267, 269; Philo Judæus, *De confus. ling.*, *Works*, tr. Yonge, 1854, ii, 40; Plotinos, *Enneads*, ii, 7, ed. Müller, 1878, i, 127; Verbeke, 34, 64–7; Zeller, (1), III, i[4], 129–31, 183.
[2] Arnim, ii, 152 f.
[3] Eisler, (3), 179.
[4] Burnet, (1), 218; VS, 1906, i, 198.
[5] Diogenes Laertios, vii, 151.
[6] Alexander of Aphrodisias, *De Mixtione*, in Ideler, (2), ii, 587 f.
[7] Schmekel, 122.
[8] Arnold, 244.
[9] Dieterich, (2), 48.
[10] Arnold, 169 f.; Bréhier, 124.

earth. Everything material is formed from them, and their matter (ὕλη) contains all the material qualities. The two groups were contrasted as upper and lower, fine and coarse, binding and bound, etc., fire and air being pneumatic substances (πνευματική οὐσίαι).[1]

Chrysippos differed from Aristotle (see p. 105) in regarding air as cold, but did not emphasise this so much as later Stoics,[2] who were followed by Galen,[3] Cardan,[4] and William Gilbert (1540–1603).[5]

In a short treatise on the first principles of cold (περὶ τοῦ πρώτου ψυχροῦ, *de primo frigido*), Plutarch[6] gives the reasons by which Empedokles and Straton proved that water is the *primum frigidum*, and those of Chrysippos to prove that this is air. Cold has an independent existence and is not just a negation or privation of heat. Chrysippos rejected earth as improbable; Plutarch gives arguments for making it the *primum frigidum*, but concluded that it is better to leave the matter in suspense.

The cold exhalations of the earth form winds and then clouds, and when these begin to divide and break up their fine particles by strong gusts, thunder and lightning are produced. Lighting is heat squeezed out of clouds by their conflict.[7] Poseidonios explained the phenomenon by dry or smoky exhalations from the earth, which break through clouds.[8] Sound is a movement spreading spherically through the air in waves, just as a pool of water is affected by a stone striking it (the movement then is circular, but the air, which is a continuum, moves spherically).[9] Chrysippos distinguished varieties of elements, e.g. fire in light and fire in glowing charcoal, and gave each element a characteristic colour, except air, which is colourless.[10]

The elements are stratified in the order earth, water, air, and fire, the first two tending downwards and the last two upwards. The transitions are gradual; lower ether is like air, so that we can speak of three elements with Herakleitos, or four with Empedokles.[11] Fire, heat, and motion are ultimately identical and are the source of life; fire is in a superior position because of its divine nature, and all elements, even earth, which nourishes plants, contain some of it ('god is in stone'), which manifests itself in cohesion (ἕξις, *hexis*), a kind of soul or spirit pervading the whole, so that water in a glass is not an inanimate object.[12]

Bodies (ἡνωμένα) are united by ἕξις as in stone or dust-motes, by φύσις as in plants, or by ψυχή as in animals. The body of the universe is not united by ἕξις since it undergoes considerable changes not suffered by the ἡνωμένα due to ἕξις. Hence it is united by a φύσις,

[1] Arnim, i, 24, 27, 110; ii, 111, 133, 136 f.; Arnold, 172 f., 180 (ether not used); Gilbert, 236, 244 f., 251, 433; J. Kroll, (1), 181; Pearson, 100; Verbeke, 37, 39, 68; Zeller, (1), III, i[4], 185, 188.

[2] Diogenes Laertios, vii, 137; Arnold, 181; Barth, 73; Zeller, (1), III, i[4], 186.

[3] Kühn, xi, 510; Arnim, ii, 133, 137.

[4] *De Subtilite*, ii; 8°, Basel, 1560, 83.

[5] *De Mundo nostro Sublunari Philosophia Nova*, 4°, Amsterdam, 1651, 22 f., 24, 92, 94 Lasswitz, i, 317; see Vol. II, p. 414.

[6] *Moralia*, ed. Dübner, Paris, 1841, ii, 1157–63; tr. *Morals*, ed. Goodwin, Boston, 1870, v 309–330.

[7] Cicero, *De Divin.*, ii, 19.

[8] Seneca, *Quaest. Nat.*, II, liv, 1–2; lvii, 1–4; lviii, 2.

[9] Diogenes Laertios, vii, 158; Arnim, ii, 425.

[10] Barth, 73–4.

[11] Arnold, 180; Barth, 72–3 (Chrysippos); Verbeke, 71.

[12] Seneca, *Quaest. Nat.*, II, ii, 4 (ad naturam corporis nulla ope externa sed unitate sua cohaerentis; Oltramare, ed. *Quaest. Nat.*, 1929, i, 57); Arnim, ii, 144, 149; Arnold, 167, 180–9; Sambursky, (2), 8, 30; Verbeke, 77.

and by the best φύσις since it contains all the φύσεις, including the reasonable φύσεις and is itself reasonable, it is the best φύσις, God.[1]

In Stoic theory, the category of disposition (πώς ἔχοντα, *res quodammodo se habens*) was replaced by ἕξις used in two senses. (i) A movement of rarefaction and condensation of *pneuma* (πνεῦμα ἀναστρέφον ἐφ' ἑαυτο), *unitas*, an air-current, the principle of growth in plants and animals, growth when united with sensation and impulse becoming soul (ψυχή, *anima*) in animals only. (ii) A temporary condition, *habitus* (used in both senses in Latin), as contrasted with a permanent disposition (διάθεσις), also a body.[2]

The Stoics[3] defined an element as 'that out of which at first all things which exist are produced, and into which at last all things are resolved (ἐστι δὲ στοιχεῖον, ἐξ οὗ πρώτου γίνεταί τι καὶ εἰς ὃ ἔσχατον ἀναλύεται)'. The same definition is given in ψ-Plato's *Definitions*.[4] It is that given by Boyle (*Sceptical Chymist*, 1661) and Stahl (*Fundamenta Chymiae*, 1723), and goes back to Aristotle (see p. 86). A fifth essence, ether or pneuma, was recognised, but it was not an element (since fire would fulfil all its functions); some of this was left over from the creation of the elements from the primary matter and this 'first pneuma', corresponding with the 'pure fire' of the Iranians and Herakleitos, floated outside the universe and ruled it as a god.[5] All the elements are formed from the divine fire. This first forms air and water, then part of the water forms air, which passes back into fire, and another part forms earth.[6] The idea that the elements are gods goes back to Thales (p. 6) and may ultimately be Oriental; it appears in Orphicism, in Persia, in Mithraism, and in Neopythagorean and Neoplatonic philosophies, and also appears in Stoicism.[7]

Ekpyrosis

Chrysippos supposed that 'evaporation (ἀναθυμίασις)' from the earth and lower spheres is used up as nourishment in the sphere of the ether and the stars, which return nearly all in the form of heat but retain a small part, which accumulates as time goes on, a kind of entropy effect.[8] This will bring about the end of the universe, when everything will have passed into fire (or at least the fiery element has reached a maximum), a condition called ἐκπύρωσις (*ekpyrosis*). After this, everything begins again and every event is repeated in the minutest detail.[9] The end of the world by fire was not its death, since the result contained the seeds of a new cosmos, and *ekpyrosis* was not a sudden conflagration. Chrysippos postulated a vacuum outside the universe into which it expands when all is converted into fire.[10] The universe is perishable in one sense, in its present order, but not in another, since its substance persists. The changes of the elements are not evenly balanced; the upward movement (ἄων) to fire is slightly in excess, and ultimately everything becomes fire and

[1] Sextus Empiricus; Festugière, (1), ii, 411.
[2] Arnim, ii, 144, 149; Arnold, 167–8; Pearson, 92, 110, 115, 161, 175, 177; Reinhardt, (2), 40, 47, 98.
[3] Diogenes Laertios, vii, 137; Loeb ed., ii, 291; tr. Yonge, 1891, 309.
[4] *Works of Plato*, tr. Burges, 1854, vi, 125. Ficinus translated 'ex quo componuntur, et in quod composita dissolvuntur'.
[5] Arnold, 173, 180; J. Kroll, (1), 7, 22, 183; perhaps from Poseidonios.
[6] Cicero, *De Nat. Deor.*, ii, 33; iii, 12; Pearson, 250 (Kleanthes); Ueberweg, (1), i, 419–22.
[7] J. Kroll, (1), 179, 184 f.
[8] Barth, 78; Schmekel, 242; Zeller, (1), III, i^4, 192.
[9] Arnold, 193; Ueberweg, (1), i, 419–22.
[10] Barth, 74.

air; living things die but not the universe, since soul is not separated from body.

When the universe has passed into its original fiery breath, a period of reconstruction (παλιγγενεσία) begins,[1] which in turn leads to a collision (σύνοδος) of all the planets or a new conflagration. Creation (διακόσμησις) is the mutation of the elements on the downward path (κάτω). When water is reached, the deity assumes the form of λόγος σπερματικὸς (see p. 158) and first begets the four elements and then animated nature. In the conflict of opposing tendencies an equilibrium (ἰσονομία) is established, making possible the apparent but not real permanence of the phenomenal world.[2]

The natural 'up and down path' of the elements is modified by the continual action of change (μεταβολή). Fire and air perpetually change into water and earth, and before their upward tendency has time to assert itself, they assume weight (βάρος) and start again in the opposite direction. Thus, each of the four elements is stationary and remains constant, whilst in reality its component parts are in continual motion.[3] There are Greek myths of the destruction of the world by fire and flood,[4] and of the Stoics by both.[5] The doctrine of world-cycles passed from Poseidonios to Middle Platonism and Neoplatonism; resemblances to accounts in the Indian *Mahābhārata* need not indicate borrowings, since this in its present form may incorporate Greek ideas.[6]

Kleanthes supposed that when everything has been set on fire, a reaction begins in the centre of the sphere (readier to admit the loosening of tension) and spreads outwards until everything is a watery mass except on the outside, where the bracing power which binds the parts of the universe together is fullest. The remaining parts of the original fire, concentrated in the sun, then exert their influence and the elements and the world are formed. This theory of tension as applied to the διακόσμησις is Kleanthes' most important contribution.[7] Karneades (214/2–129/8 B.C.), the founder of the Third (New) Academy and an opponent of the Epicureans and Stoics, objected that 'if everything turned into fire, this would go out for lack of fuel', and Panaitios and Boëthos gave up the doctrine of *ekpyrosis*, but Poseidonios re-introduced it.[8]

The interval between one conflagration and the next is a 'great year (περίοδος, *magnus annus*)', after which the sun, moon, and planets all return to their original stations. This is mentioned by Plato[9] and Berossos, and is probably Babylonian.[10] Unlike the Epicureans, who held that the worlds are infinite in number, Zeno and the Stoics taught that there is only one universe (ἕνα εἶναι τὸν κόσμον).[11]

[1] Seneca, *Quaest. Nat.*, III, xxx, 7–8.

[2] Arnim, i, 32, 183; Arnold, 190–7; Heinze, 99.

[3] Pearson, 123. Seneca, *Quaest. Nat.*, III, xxix, 1, perhaps from Poseidonios, attributes the theory of ekpyrosis (and also a flood) to Berossos and hence Babylonian, but it is not found in cuneiform texts (which have an account of a flood): Jeremias, 193 f.; Stegemann, 91. It may be Persian: Gressmann, (2), 10.

[4] Pearson, 110, 113; Plato, *Tim.*, 22B–E; Roscher, Ro., iii, 2189.

[5] Zeller, III, i[4], 152, 157, 159.

[6] Dodds, (1), 302 (ἀποκαταστασις 'doubtless ultimately Babylonian').

[7] Pearson, 252–4: a difficult passage in Stobaios.

[8] Arnold, 103, 192; Schmekel, 188, 241.

[9] *Tim.*, 39D.

[10] Arnold, 193; Boll, (3), 200.

[11] Pearson, 117.

Logos

The λόγος or creative potentiality (δύναμις πνευματική), acts through 'seeds (σπέρμα)' or λόγοι σπερματικοί (*logoi spermatikoi*), a Stoic technical term which has been translated as seminal reasons, seed forms, seed powers, generative ratios, rational germs, constitutive formulae, etc. These are disseminated through the universe, permeating matter and giving it properties, form, and qualities, and the capacity of growth, development, and generation. They have a spiritual activity as λόγοι and a material as σπερματικοί, and stand in relation to the qualities (ποιότητες). As the *logos* was identified with *pneuma*, the *logoi spermatikoi* were (as in the Pneumatic School of medicine, see p. 183) identified with the separate *pneumas*. The idea of 'forces' seems to have been developed first by the Neoplatonists (see p. 225).[1]

The development of the meaning of *logos* from 'word and speech' to its many later meanings is complicated. It is suggested[2] that it corresponds with the Egyptian *mā-khrū* or creative speech of the god Thoth, and similar attributes of the Babylonian god Marduk, which were connected with Hermes as the spirit of the cosmos, and Plato (*Kratylos*) connects *logos* with Hermes and (by false etymology πᾶν = Πάν) with Pan. The Stoics identified the *logoi spermatikoi* with Hermes.

Logos in the Fourth Gospel exists as a hypostasis distinguishable from God yet remaining with Him.[3] Cudworth[4] identified the Stoic 'seminal reasons' with a 'plastic nature' or 'vegetative soul', much the same as the *Archeus* of 'the Chymists and Paracelsians' (Van Helmont) and the *vis curatrix* of Hippokrates.[5]

Pneuma

The word *pneuma* (πνεῦμα), probably derived from πνέω, I blow,[6] developed several meanings in Greek philosophy and medicine.[7] For the Ionians and Atomists it was moving air and breath;[8] for Plato inhaled air;[9] for Anaximenes and the Pythagoreans a 'boundless breath' outside the heavens, which was inhaled by the world. Anaximenes sometimes makes it a void keeping the units separate from one another, and the Pythagoreans thought it was air (αήρ) because it was moved and the air is full of souls.[10] Xenophanes first took it as 'life breath' or soul (ψυχή).[11] In Hippokrates it is wind (ἄνεμος) and 'the food of fire (πυρὶ τὸ πνεῦμα τροφή)'.[12] For Aristotle and the Peripatetics it is driving wind which can be ignited to lightning,[13] but Aristotle also developed the idea

[1] Arnold, 161; Baeumker, 346 f., 356 f.; Bréhier, 122; Deussen, (1), II, i, 415 f.; Drummond, i, 102; Gilbert, 239, 251 f., 392; Heinze, 95, 107 f., 123 f.; Leisegang, PW, xiii, 1036 f., 1055 f.; A. E. Taylor, *J. Hellenic Stud.*, 1912, xxxii, 414; Whittaker, (1), 1918, 36; Zeller, (1), III, i[4], 136, 144, 151, 162; but see Poseidonios.

[2] Leisegang, PW, xiii, 1036 f., 1055 f., 1078 f.

[3] Dodd, (2), 263–85 (264, 267, 269, 280).

[4] i, 232, 260.

[5] Hippokrates, *Opera*, ed. Vander Linden, 1665, i, 809. Cicero, *Tusc. Disput.*, iv, 10, said the Stoics, particularly Chrysippos, exaggerated an analogy between diseases of the body and those of the soul.

[6] Verbeke, 1.

[7] Dodd, (2), 213–27; Gilbert, 568, and index under 'pneuma'; R. James, iii, art. Pneuma; Sambursky, (2), 1959, 21–48.

[8] Gilbert, 620.

[9] Gilbert, 366.

[10] Burnet, (1), 108–9; Rohde, ii, 162.

[11] Diogenes Laertios, ix, 2, ed. Cobet, 1850, 231; Rohde, ii, 258.

[12] *De Flatibus*, v, 16; *Opera*, ed. Vander Linden, 1665, i, 402; *Werke*, 1895, Fuchs, i, 442.

[13] Aristotle, *Opera*, Paris, 1854, iii, 592, etc.; 1874, v, 786 (index); Arnim, ii, 144; Gilbert, 268, 305, 323, 629, 633.

of innate pneuma (σύμφυτον πνεῦμα) (see p. 122). The Stoic pneuma, by its 'spring' or τόνος, supported the earth and bound the universe together.[1] By a development of the Aristotelian idea of active and passive elements, it became a spiritual 'force' penetrating matter, acting as a creative principle, and causing life, motion, sensation, soul, and thought.[2] It was the principal agent in all natural phenomena.[3]

The idea of *pneuma* may have reached Zeno from a medical source, as a moving force in living beings, perhaps through Aristotle.[4] Kleanthes perhaps first introduced πνεῦμα, which is the same as the πῦρ of Herakleitos, whilst Zeno had taken this as ether (αἰθήρ);[5] in later times pneuma and ether were identified. Kleanthes called Zeno's 'creative fire' 'flame (φλόξ)', identifying it with the sky, the sun, and the power of heat (*vim caloris*),[6] and perhaps first used the name πνεῦμα (*spiritus*) for it, identifying this with fire (πῦρ) or heat.[7] Zeno and Kleanthes put *pneuma* above the four elements as their principle and source, but for Chrysippos it was a union of air and fire.[8] It is the central idea in Stoicism as (*a*) a principle of unification, (*b*) a subtle (λεπτότατον) material, (*c*) the soul of the world, outside matter, a compound (κρᾶσις δι' ὅλων) of fire and water (Kleanthes), (*d*) Poseidonios, as a concession to Plato, separated matter and *pneuma*, and made mind (νοῦς) transcendent.[9] It is supposed[10] that Stoic physics is a 'dynamic notion of the concept of continuity', based on *pneuma*, which endows matter with cohesion and physical qualities, and that ἕξις (*hexis*,) corresponds with a 'field of force'.

The 'innate pneuma (σύμφυτον πνεῦμα)' was located as an *aura* in the blood (although some located it in the brain), which it entered at birth, giving life, and left it on death, passing into the region of pneuma and ether above the air. Sleep was an intermediate state, passing into waking consciousness by absorption of pneuma.[11] In Aristotle, pneuma is an *aura* surrounding the sperm, part of the soul of the parent and of his ancestors, whose characteristics may develop in later generations,[12] and some Stoics called the soul 'seeds (σπέρμα)'.[13] For the Stoics the male sperm consists of moisture (ὑγρον) and πνεῦμα; in the uterus the πνεῦμα combines with the female πνεῦμα, which is μέρος ψυχῆς τοῦ θήλεος, 'part of the female soul', and the soul of the embryo originates from the souls of both parents. The φύσις or combination of the two πνεύματα moulds the body from the moist part (ὑγρα οὐσία) of the male sperm; it is present itself in

[1] Baeumker, 342 f.; Heinze, 93 f.
[2] Arnold, 89; Baeumker, 367 f.; Gilbert, 251 f., 292; Heinze, 97 f.
[3] Gilbert, 305 f., 323, 629.
[4] Aristotle, *De Animal. Motione*, *Opera*, Paris, 1854, iii, 517 f.; Gilbert, 305 f.; Jaeger, *Hermes*, 1913, xlviii, 29; MGM, xii, 326.
[5] Pearson, 40, 86, 245–6.
[6] Arnim, i, 111–12, 115; Cicero, *De Nat. Deor.*, i, 14; ii, 9, 15.
[7] Arnold, 89; Zeller, (1), III, i⁴, 137, 146.
[8] Verbeke, 89.
[9] Sagnard, (1), 579 f.; Verbeke, 11 f. (*a*), 30 f. (*b*), 66 (*c*), 136 (*d*), 142.
[10] Sambursky, (1), 182, 202; (2), vii f., 1 f., 21, 31, 36; Gillespie, *Isis*, 1958, xlviii, 357.
[11] J. Kroll, (1), 280 f., 288, 301; Verbeke, 318; Zeller, (1), III, i⁴, 198 f.
[12] *De gen. animal.*, ii, 3; iv, 3; *De hist. animal.*, vii, 6; *Opera*, Paris, 1854, iii, 252.
[13] Arnim, ii, 211; Arnold, 161; Gilbert, 239, 252; Heinze, 110. Until after the time of Haller (1708–77) the agent of fertilisation was supposed to be an aura rising from the sperm (G. H. Lewes, *Aristotle*, 1864, 356) and the same idea persisted longer in botany (J. R. Green, *A History of Botany in the United Kingdom*, 1914, 142, 144, 193 f., 197, 328).

the embryo like a vegetable soul and on birth changes into a soul (ψυχή) on contact with the cold air. The female produces no sperm and the body of the embryo, in contrast with its soul, comes from the father only. Hierokles (2 cent. A.D.) assumed that the φύσις changed into the ψυχή before birth.[1]

On another view, *pneuma* is a kind of soul substance; birth is a conversion of *pneuma* into soul (μεταβολὴ τοῦ πνεῦματος εἰς ψυχήν) and death the reverse. The soul is a very fine intellectual fire (πῦρ νοερόν). The world soul fills the cosmos with activity and life.[2] *Pneuma* was also a unity of passive matter (ὕλη), conceived as an aggregate of the elements, and active spirit (οὐσια), in the form of *logoi spermatikoi* (see p. 158) scattered by Hermes in the cosmos to cause development by their action on ὕλη.[3]

In the later Hellenistic period, the philosophical ideas on *pneuma* were combined with revivals of old animistic and superstitious beliefs, and magic; it became *gnosis*, or magic formulae and incantations.[4] The spiritualisation of pneuma into 'holy spirit (πνεῦμα ἅγιον)' began with Philo Judaeus (see p. 179).[5]

Soul

The soul, *psychē* (ψυχή) was for the Stoics a 'body', but never 'matter', and body and soul are a unity. We perceive bodies by touch and learn the workings of the soul by an 'inward touch (ἐντὸς ἁφή)'. Man has body (σῶμα), soul (ψυχή, *anima*), and mind (νοῦς, *animus*). The soul is creative fire, also air or breath, a mixture of fire and air, or warm air (πνεῦμα).[6] As Plato taught, it is self-moved (αὐτοκίνητον), but not, as he assumed, the same as 'life' (ψυχή = ζωή). It has eight activities (δυνάμεις),[7] which should not be called 'parts' (although they often are), since the soul, properly speaking, has no parts. These are the ruling activity (ἡγεμονικόν, *principatus*), the five senses, and the powers of speech and generation. The ruling activity, which is situated in the heart as the centre of the body, has powers of growth and sensation; it governs the other activities, each of which is associated with a particular and separate bodily organ. It corresponds with intellect, reason, and will, and sends its powers to the five sense organs, which are passively affected by things perceived. Rays leave the eye, causing tension in the air and reaching towards an object in a cone (even darkness is visible); the object emits another efflux meeting the first, and the two become mutually absorbed; hence Poseidonios called sight 'absorption (σύμφυσις)'.[8]

On its release from the body the soul assumes the shape of a sphere, and, as

[1] Waszink, 344 f. and refs.

[2] Gilbert, 251, 292; Höfer, Ro., iii, 2584; J. Kroll, (1), 75, 124, 135, 266, 285 f., 301; Reitzenstein, (4), 1910, 139.

[3] Eitrem, PW, viii, 791; J. Kroll, (1), 32, 124 f., 141.

[4] Preisigke, *A. Rel.*, 1926, xxiv, 112; Reitzenstein, (4), 1910, 138 f.

[5] *Works*, tr. Yonge, 1854, i, 331; Dieterich, (2), 1903, 117; J. Kroll, (1), 76; Verbeke, 387, 396, 400 (disagreeing with Leisegang): St. Paul still distinguished spirit (πνεῦμα) and vital force (ψυχή). The *pneumas* (πνεύματα) became good angels and evil demons floating in the air like pleasant and unpleasant odours.

[6] Arnim, i, 38; ii, 218; Arnold, 157, 242 f.

[7] Pearson, 307, perhaps Kleanthes.

[8] Arnim, ii, 232 f.; Arnold, 89, 168, 243–51; Sambursky, (2), 23; Schmekel, 195, 324.

a compound of fire and air, rises to a region just below the moon, living (like the stars) on exhalations from the earth, the air being full of demons.[1]

From the sun, the source of all life, souls pass to the moon, and on their way from there to the earth dwell in the space below the moon as demons (δαίμονες), composed of light and fire, and heroes, composed of air; the air is full of them (an idea which goes back to Hesiod).[2] Plutarch[3] said that man is composed of mind (νοῦς) supplied by the sun, soul (ψυχή) supplied by the moon, and body (σῶμα) supplied by the earth. On death the νοῦς and ψυχή rise, and after a period between the moon and the earth, separate in a 'second death' and return to their original places, the δαίμονες on the moon sometimes descending to the earth.[4]

The soul, a warm breath (πνεῦμα ἔνθερμον), part of, or an efflux from, God, lasts longer than the body; Kleanthes said all souls lasted until the *ekpyrosis*, Chrysippos only the wise souls. The soul is pneuma or intelligent heat (νοερὸν θερμόν), part of the divine fire. The divinity is fire (πῦρ), warm breath, formative fire (πῦρ τεχνικόν), active breath diffused through the cosmos (πνεῦμα διῆκον δι' ὅλου τοῦ κόσμου); it passes into the coarser elements and these return to it.[5]

Plants have no souls (Plato said they had) but animals have. The Stoics had a ladder of being, the lowest step having an inorganic 'state (ἕξις)', plants 'nature (φύσις)', which is ἕξις in motion, animals 'soul (ψυχή)', and man 'reason (λόγος)'. Anything with a higher grade has also all the lower. Happiness (εὐδαιμονία) results from living in accordance with nature (ὁμολογουμένως τῇ φύσει ζῆν, *secundam naturam*),with a scientific knowledge of nature; and action, not contemplation, is the highest duty of man.[6] The growth power (φυσίς) of plants resides or originates in the root,[7] from which spirit spreads upwards; growing plants may split strong rocks.[8]

Panaitios first regarded soul (ψυχή) as composed of fire (πῦρ) and air or pneuma (πνεῦμα).[9] Zeno had identified soul with fire;[10] he said the body, like fire, is nourished by 'evaporations', especially from the blood, and Kleanthes assumed that these represent the soul united with the body.[11] The sun, which is a fire, is nourished by evaporations from the sea, the moon by those from rivers and fountains, and the stars by those from the earth.[12] The stars are all gods.[13] The sun is the heart of the universe (καρδία τοῦ παντός), an intelligent light (φῶς νοερόν), regulating cosmic processes, master of the four elements and creating and destroying animals and plants.[14]

[1] Arnim, ii, 224–5; Arnold, 263–4.
[2] Adam, 72; Arnold, 269; G. Murray, (1), 173.
[3] *De facie in orbe lunae*, 28; Stewart, (1), 440 (for Apuleius, *ib.*, 445).
[4] Reinhardt, (2), 1926, 311 f., 320; Verbeke, 262–4, 342.
[5] Ueberweg, (1), i, 422; Zeller, (1), III, i[4], 144, 205. Aristotle, *De anima*, i, 2, 405*b*, said some related ζῆν (to live) and ζέειν (to boil) because the soul is heat (θερμός).
[6] Arnold, 186, 190, 282; Festugière, (2), iii, XCIX; Ueberweg, (1), i, 422–5.
[7] Cicero, *De Nat. Deor.*, ii, 11; cf. Aristotle; the root is the 'head'.
[8] Seneca, *Quaest. Nat.*, II, vi, 5.
[9] Schmekel, 198, 324.
[10] Cicero, *Tusc. Disp.*, I, ix, 19.
[11] Barth, 24; Pearson, 138.
[12] Poseidonios; Arnold, 181, 184–5; Porphyry, *De antro nymph.*, in T. Taylor, *Commentary of Proclus on the First Book of Euclid's Elements*, 1792, ii, 283; Reinhardt, (2), 107. Newton thought animals and vegetables on the earth are nourished by watery exhalations from the tails of comets; see Vol. II, p. 485.
[13] Cicero, *De Nat. Deor.*, ii, 15.
[14] Arnold, 184; F. Cumont, *Mém. Acad. Inscr.*, Paris, 1913, xii, 458–66; for an old Egyptian parallel see Bonnet, 61.

Astrology

The Stoics paid much attention to astrology.[1] They also called the planets 'letters or elements (στοιχεῖα)' and denoted them by the seven vowels αεηιουω; they are rulers of the days, years, and ages, and also rulers of the universe (κοσμοκράτορες, *kosmokratores*), causing all events.[2] All events are due to the fatal energy (εἱμαρμένη, *heimarmenê*) residing in the sky and the celestial gods are universal.[3]

Chrysippos first introduced the idea of an interdependence of all parts of the cosmos, which he called συμπάθεια, 'sympathy' or 'influence'.[4] The diffusion of reason in nature (φυσικὸς λόγος, *ratio physica*) linked everything together in bonds of sympathy or fate (εἱμαρμένη, *fatum*), 'providence (πρόνοια)' being the same word in Greek as 'knowing beforehand'; this universal bond put divination (μάντις) or soothsaying on a rational basis, which appealed to the Romans.[5] Pliny[6] often mentions the theory of sympathy and antipathy as of Greek origin.

The Stoic theories of εἱμαρμένη and universal sympathy (συμπάθεια τῶν ὅλων) gave an impulse to belief in astrology, one of the main points of disagreement between Academics and Stoics.[7]

An idea related to the theory of sympathy, but originally not connected with astrology, is that of the macrocosm and microcosm and this idea was accepted by the Stoics and developed especially by Poseidonios.[8] It is well developed in Seneca. Zeno and all later Stoics regarded the universe as a rational animal.[9]

Poseidonios

Poseidonios of Apamea in Syria (135–51, or 139–60, B.C.) was a pupil of Panaitios. He travelled extensively, settled in Rhodes in 97 B.C., was ambassador to Rome in 86 B.C. and was a friend of Pompey and many distinguished Romans. He probably died in Rome. Poseidonios was greatly interested in science, but was superstitious. He incorporated varied elements in his philosophy but it remained essentially Stoic.[10] Some think he was mainly responsible

[1] Arnold, 182; Barth, 75; Festugière, (1), ii, 400; Reinhardt, (2), 131 f.; W. Scott, (1), ii, 444.

[2] Dieterich, (1), 157, 171; G. Murray, (1), 175; Reitzenstein, (2), 259, 270.

[3] Arnold, 199, 229, 231; Bouché Leclercq, 572; Cumont, (1), 171, 194, 196; (2), 113, 153; J. Kroll, (1), 44, 49; Reitzenstein, (6); Roscher, *A. Rel.*, 1898, i, 56; Wernicke, Ro., iii, 1382, 1468; Wetter, 150.

[4] Arnold, 239; Barth, 72, 76; Reinhardt, (2), 50, 54, 248 (thinks Poseidonios introduced this idea); Sambursky, (2), 41; Verbeke, 71.

[5] Brandis, (1), III, ii, 535–41; Festugière, (1), i, 90; Ueberweg, (1), i, 422–3; Zeller, (2), 249–50.

[6] ix, 88; xxiv, 1; xxviii, 23; xxxii, 12; xxxvii, 15.

[7] Arnim, i, 121; ii, 299; Arnold, 200 f.; Barth, 89; Boll, (3), 168 f.; Deussen, (1), II, i, 401; de Faye, 262 f., 281, 296; Festugière, (1), i, 90 f.; Gundel, PW, vii, 2622; Pfeiffer, (1), 48, 63; Reinhardt, (2), 51, 53, 111, 178; Riess, PW, ii, 1813; J. Röhr, Der okkulte Kraftbegriff in Altertum, *Philologus Suppl.*, 1923, xvii, 1–133; Verbeke, 104; Zeller, (1), III, i[4], 172, 334 f., 354 f., 712.

[8] Arnold, 240 f.; Reinhardt, (2), 118 f.; Reitzenstein, (2), 259; (7), 7, 61 f., 70 f., 114, 118, 130, 147; Zeller, (1), III, i[4], 165.

[9] Arnold, 184–5.

[10] Arnold, 105; Brandis, (1), III, ii, 535; Deussen, (1), II, i, 401; Dieterich, (2), 1903, 58, 79, 156, 204; Gilbert. 266; Gressmann, (2), 13; Heinze, 169; Honigmann, *Isis*, 1930, xiv, 463;

for the transmission of Oriental knowledge to the West,[1] and was a true observer of nature; others that his influence and originality have been exaggerated.[2] His works are lost except for fragments. Reinhardt has perhaps attributed too much to him.[3]

Poseidonios contributed a theory of a vital force (ζωτικὴ δύναμις, *vis vitalis*) originating in the sun and permeating the world with its warming breath (πνεῦμα). The world is a graduated structure, ascending continuously from minerals through plants and animals to man, who is the 'chain (δεσμός)' linking the sublunary world with the imperishable world above the moon. He introduced the idea of an intellectual force (λογικὴ δύναμις). Matter and spirit are two aspects of the same being; the difference is only in the subject, and in the object (κατὰ τὴν ὑπόστασιν) they coincide. He thus transformed the πῦρ τεχνικόν into an organising force. What Cicero calls *vis seminis* (δύναμις σπερματική ?) is a compound of force and action (effect), as λόγος σπερματικὸς (which is different from ζωτικὴ δύναμις) was ὕλη + λόγος. For Poseidonios τόνος is not material but a force. Air gives to heaven what it receives from earth and conveys the force of the stars to the earth.[4] Macrobius[5] says Poseidonios taught that the Milky Way is an outpouring of a sidereal substance which compensates the uneven heating effect of the sun. The sun is fiery, hot, active, and male; the moon is cold, watery, passive, and female; the other planets have temperatures depending on their positions in the universe.[6]

In his commentary on Plato's *Timaios* Poseidonios develops the Pythagorean theory that the starting point is the unit (μονάς) from which numbers and the elements evolve by a principle of flux; unity and two differ as force and matter.[7] His doctrine of the logos was perhaps a direct source for Philo Judæus,[8] and he probably influenced the *Hermetic Books*.[9] Poseidonios thought that after death the soul lives unchanged in the air until the next conflagration, going higher up the better it is. He followed Aristotle in locating the soul in the heart.[10] He admitted two principles, matter, and pneuma penetrating it as the soul does the body.[11] He taught that there are three kinds of bodies: (i) those composed of separate independent things, as armies, (ii) those composed of adjusted parts (ἐκ συναπτομένον), as a ship or a chain, (iii) those which are units in the narrower sense, penetrated by an internal unifying

Hopfner, (1), xii; W. Kroll, *N. Jahrb. klass. Alt.*, 1917, xxxix, 145; Mattingly, *Osiris*, 1937, iii, 558–83; Reinhardt, (1), (2), PW, 1953, xliii, 558–826; Reitzenstein, (1), 73; Schmekel, 9 f., 85, 238, 382; Schmidt, in Christ, 1913, II, ii, 670; Susemihl, ii, 128; Tarn, (1), 313, Treves, OCD, 722; Verbeke, 110–41; Zeller, (1), III, i[4], 592; (2), 249. List of works in Schmekel; 13 (24 titles).

[1] Capelle, *Hermes*, 1925, lx, 375 (383); Stemplinger, 94; Wendland, 60.

[2] Von Gaertringen, PW, 1931, Suppl. v, 826; Tarn, (1), 314; Verbeke, 110–11; Weinreich, *A. Rel.*, 1925, xxiii, 82.

[3] R. Munz, *Poseidonios und Strabon*, Göttingen, 1929.

[4] Seneca, *Quaest. Nat.*, II, iv, 1; Reinhardt, (1), 141 f., 240–4, 249.

[5] *Somn. Scip.*, I, xv, 7; ed. Eyssenhardt, Leipzig, 1893, 546; Reinhardt, (1), 250.

[6] Reinhardt, (2), 375–6, with refs. to astrological works.

[7] Arnold, 104; Schmekel, 428, 436.

[8] Arnold, 105.

[9] Verbeke, 110–11.

[10] Galen, *De Plac. Hipp. et Plat.*, ed. Müller, Leipzig, 1874, 501; Schmekel, 259.

[11] Schmekel, 239, 248 (true only in a qualified sense); Verbeke, 136 f.

principle, as plants and animals;[1] and four kinds of change: (i) separation (κατὰ διαίρεσιν) in which the parts remain unchanged, (ii) alteration (κατ' ἀλλοίωσιν) in which the smallest parts acquire a new property, (iii) fusion together (κατὰ σύγχυσιν) in which the parts unite with complete change of properties, and (iv) dissolution (ἐξ ὅλων, λεγομένην δὲ κατ' ἀνάλυσιν), which is the inverse of (iii).[2] Reinhardt[3] thinks σύγχυσις was used by Chrysippos, μῖξις and κρᾶσις by Poseidonios, and[4] that Poseidonios had no clear idea of true chemical change, since he gives an example of a τετραφάρμακος of a mixture of wax, gum, tallow, and pitch, also quoted by Galen[5] and Philo Judæus. He knew the atomic theory (which he attributed to Mōchos the Phoenician),[6] and the criticism that particles of stone do not cohere.[7] In describing the solidification of asphalt from the Dead Sea by pouring urine and other fetid liquids on it and uttering incantations, Poseidonios says the incantations are not the cause but the urine may have some particular power, as chrysokolla (uric acid ?) is found in the bladders of persons suffering from the stone and in the urine of children (εἰ μή τίς ἐστιν ἐπιτηδειότης τῶν οὔρων τοιαύτη, καθάπερ καὶ ἐν ταῖς κύστεσι τῶν λιθιώντων).[8]

Poseidonios believed that each element has only *one* of the fundamental properties: fire warmth, air cold, water moistness, and earth dryness (cf. Aristotle, p. 86), and tried to prove that air, not water, is the principle of cold by experimenting with the air of marshes.[9] He assumed a vacuum outside the universe, not infinite but large enough to accommodate the dissolution of the universe, which he (and Boëthos) said does not occur by fire.[10] Kleomedes (2 cent. A.D.) argued that there must be some contractile force in the earth to prevent it from dissipating into this vacuum, and this anticipation of the idea of gravitation may have come from Poseidonios.[11] Poseidonios thought that comets are produced by condensation of air.[12] He made careful observations on earthquakes.[13]

He gave a long account[14] of metals in Spain, mentioning gold washing, and the separation of gold from silver in electrum (which he knew was a mixture of these two metals) by heating with 'a kind of aluminous earth', the use of Archimedes' screw for lifting water from mines, and tin in the Cassiterides and the British Isles (which he distinguishes). He described mineral waters[15] and juices of the earth which 'ripen' into metals or become stones, and those

[1] Reinhardt, (1), 346; (2), 22, 34; Schmekel, 238 f.

[2] Areios Didymos, fr. 28, in Diels, *Doxographi Graeci*, Berlin, 1879, 463; Brandis, (1), III, ii, 536; Reinhardt, (1), ii, 40, 42.

[3] (2), 5–20, 32.

[4] *Ib.*, 13–14.

[5] *De element. ex Hippocrat.*, i, 5; Kühn, i, 452.

[6] Strabo, XVI, ii, 24, 757C.

[7] Cicero, *De Nat. Deor.*, ii, 32; Reinhardt, (2), 34.

[8] Strabo, XVI, ii, 43, 764C. Reinhardt, (2), 259, thought ἐπιτηδειότης means chemical affinity but is wrong in saying that Poseidonios first took account of chemistry; Plato and Aristotle had done this.

[9] Diogenes Laertios, vii, 137; Plutarch, *De Primo Frigido*; in *Moralia*, ed. Dübner, Paris, 1841, ii, 1157 f.; *ib.*, tr. Goodwin, Boston, 1870, 322; Reinhardt, (2), 347; Schmekel, 240; J. G. Schneider, (1), 1801, i, 255; ii, 145.

[10] Philo Judaeus, ed. Mangey, 1742, ii, 497; *Works*, tr. Yonge, 1855, iv, 34.

[11] Festugière, (1), ii, 483.

[12] Seneca, *Quaest. Nat.*, VII, xxi, 1.

[13] Tozer, 198.

[14] Strabo, III, ii, 8–9; 145C.

[15] Seneca, *Quaest. Nat.*, III, i, ii, xx–xxvi; Vitruvius, *Archit.*, viii, 3.

in which earth and water change by 'putrefaction' as in earth wax (bitumen) and similar liquids.[1] The experiment in which a ring just out of sight at the bottom of a dish becomes visible on pouring in water (Kleomedes, 2 cent. A.D.) may be his.[2]

An account of the origin of gems in Arabia from the purest water congealed, not by cold but by divine heat or the light of the sun, and coloured by exhalation of pneuma[3], is probably by Poseidonios. All colours, including the rainbow and the feathers of birds, are an effect of light (τὰ χρώματα τὸ φῶς ἀπεργάζεσθαι). The emerald (σμάραγδος) and aquamarine (βηρύλλιον), which occur in copper mines, derive their colour from divine material or heavenly fire, the chrysolite (χρυσόλιθος) bears the colour of the sun; the carbuncle (ἄνθραξ) contains more or less light which was enclosed in it as it became solid; the imitation topaz (ψσευδοχρυσόλιθος), made by man, is coloured by earthly fire. This would be coloured glass.[4]

Poseidonios shows the beginnings of gnosis: the human πνεύμα is part of the divine; in the ordinary state it is bound by sensations, but in dreams or in the state of ecstasy it is free and 'knows' the relations of things, and can rise to heaven and look on the stars. This idea appears in many other sources.[5] Poseidonios believed in the doctrine of the macrocosm and microcosm, astrology, divination, demonology, and magic.[6]

Roman Stoicism

The attitude towards philosophy in Imperial Rome was generally highly unfavourable. Domitian (A.D. 81–96) twice banished philosophers from Italy, although he sent scribes to Alexandria to copy books in the Library. Trajan established a library (there were public libraries in Rome from the time of Augustus, and private libraries were fashionable), and Hadrian, Antoninus Pius, Marcus Aurelius, and Alexander Severus were interested in philosophy. Caracalla (A.D. 211–17) ordered the works of Aristotle to be burnt and his followers exterminated.[7] Roman scientific writers are usually lacking in originality, but quite often show more sound commonsense than their Greek contemporaries.

Marcus Terentius Varro (116/15–27/25 B.C.), besides writing three books on agriculture, was considered a universal scholar of the type of Poseidonios, whose ideas he transmitted to Pliny and Vitruvius, and also Neopythagorean mysticism to Aulus Gellius and Macrobius.[8] Marcus Tullius Cicero (106 B.C.–A.D. 43), who said 'antiquity has erred in many respects',[9] rejected the

[1] Seneca, *Quaest. Nat.*, III, xv, 3; Reinhardt, (1), 116.
[2] Donkin, DBM, i, 792; Sambursky, (1), 138.
[3] Diodoros Siculus, ii, 52; Blümner, iii, 249; Hoefer, (1), i, 159; (5), i, 173; Lenz, (3), 33; Reinhardt, (1), 132; (2), 343, 383.
[4] Rossbach, PW, vii, 1104.
[5] Bouché Leclercq, 545; J. Kroll, (1), 357 f., 368 f.; Reitzenstein, (4), 1910, 93 f., 125.
[6] Arnold, 200, 240 f.; Boll, (3), 210 f.; Inge, (1), 1918, i, 50; Reinhardt, (2), 118; Verbeke, 127.
[7] Sprengel, (1), 1815, ii, 152 f.
[8] Dahlmann, PW, 1935, Suppl. vi, 1172–1277; Schmekel, 104.
[9] *De Divinatione*, ii, 33.

Chaldaean idea that animate and inanimate things are influenced by the stars,[1] and on the whole was an enemy of superstition. His attack on divination,[2] full of Roman common-sense, has a modern ring. He professed to be a Platonist but in his *De Natura Deorum*, *De Finibus Bonorum et Malorum*, and *Tusculanarum Disputationem* he gives a good account of Epicureanism and Stoicism, based on original sources.[3] Ovid (43 B.C.–A.D. 17 ?) was under Pythagorean influence from Poseidonios through Varro; his *Metamorphoses* contains little which is scientific but mentions petrifying waters and has some information of geological interest (shells on the tops of mountains, etc.).[4] Seneca borrowed several examples from it.

SENECA

Lucius Annaeus Seneca (Cordova, 5 B.C.–Rome, A.D. 65), the tutor of Nero, was eclectic, combining the atomism of Epikouros with the physics of Stoicism. His *Quaestiones Naturales*, composed in A.D. 61–4, largely derived from Poseidonios, discusses physical and natural phenomena from the point of view of the atomic theory, and although not very original was much read and quoted in the Middle Ages.[5] Seneca speaks of the 'laws of Nature'[6] and was the first to believe in the progress of knowledge or science as distinct from man or society.[7] He may have obtained Poseidonios's views through Asklepiodotos (1 cent. B.C.) (a pupil of Poseidonios), whom he mentions several times.[8] The second book of the *Quaestiones* collects the ancient theories of thunder and lightning. Seneca[9] mentions the magnifying effect of a glass globe filled with water (Pliny mentions its action as a burning glass), and refraction of light in water and (also dispersion) in glass.[10] He gives an accurate theory of floating bodies,[11] says plants are nourished by air inside the earth,[12] and gives a clear account of the doctrine of *tonos* (see p. 152).[13] He[14] quotes Zeno as saying that comets are planets, but[15] differed from the Stoics in thinking that comets are regular parts of the celestial world. He believed in the influence of the planets on human affairs.[16] Seneca repeats Plato's idea (see p. 60) that metals are formed in the earth from water.[17] There are passages in the earth, some traversed by water, other by pneuma (*spiritus*), so that the earth resembles the human body; in it are various humours which soften it or which remain liquid. Hence metals are formed in the earth.

[1] *De Divinatione*, ii, 42–7.
[2] *De Divinatione*; summary in Thorndike, (1), 269–73.
[3] Festugière, (1), ii, 370; Schmekel, 155 f.
[4] *Metam.*, xv, 280 f., 331.
[5] Ed. Gercke, Leipzig, 1907; tr. J. Clarke with notes by A. Giekie, *Physical Science in the Time of Nero*, 1910; ed. and tr. Oltramare, *Questions Naturelles*, 2 vols., 1929 (Coll. Budé); Arnold, 113; Dill, (1), 7, 289, 300; Sambursky, (1), 219; Zeller, (1), III, i⁴, 194.
[6] Barth, 168; Thorndike, (1), i, 100.
[7] Oltramare, I, xxviii.
[8] Seneca, *Quaest. Nat.*, II, xxvi, 6; II, xxx, 1; V, xv, 1; VI, xvii, 3, xxii, 2; Oltramare, i, 77; ii, 272 (doubtful); Reinhardt, (1), 139.
[9] *Quaest. Nat.*, I, vi, 5; Pliny, xxxvi, 67; xxxvii, 10 (also quartz lenses, *pilae*); Blümner, iii, 298, 300.
[10] *Quaest. Nat.*, I, vi, 5–6.
[11] *Ib.*, III, xxv, 5–9.
[12] *Ib.*, VI, xvi, 1–4.
[13] Arnold, 115.
[14] *Quaest. Nat.*, VII, xix, 1.
[15] *Ib.*, VII, xxii, 1.
[16] *Consol. ad Marciam*; *Opera*, 1652, 120.
[17] *Quaest. Nat.*, iii, 15; *Opera*, ed. Ruhkopf, Leipzig, 1811, v, 172; Hoefer, (1), i, 185.

CHAPTER VIII

ALEXANDRIA

The city of Alexandria (Ἀλεξάνδρεια) was founded by Alexander the Great at the mouth of the Nile in 331 B.C. On his death in 323 B.C. his body was brought from Babylon in a gold coffin and buried in Alexandria; this was replaced by a glass coffin by a later Ptolemy; the place of the tomb is lost.[1] In 200 B.C. Alexandria was the largest city in the world; in the time of Augustus (63 B.C.–A.D. 14) the population was about a million. From about 200 B.C. Greeks and Egyptians intermarried, some natives took Greek names (the name is no guide to the nationality) and some Greeks adopted the Egyptian religion.[2] The walled city, approximately rectangular, had two main streets crossing at right-angles. The native quarter, an extension of the old village Rhakōtis, was on the west, outside the walls. The royal quarter, the Broucheion, was partly on a promontory called Lochias and partly inland towards the east, the palace being probably a cluster of halls. The Jews lived in a separate quarter east of the Broucheion. In the royal quarter were the tomb of Alexander, temples and gardens, and the Museum. The temple of Sarapis, built on an artificial mound with vaulted cellars beneath it, was in or near the Rhakōtis quarter.[3]

The Pharos or lighthouse, on an island of the same name, was built for Ptolemy I at a cost of 800 talents (about £18,000). Its height was 370 to 500 ft. After the 1 cent. A.D. it was lighted with powerful lamps and a concave reflector. It lasted till A.D. 1326.[4] The extensive harbours, docks, and quays were crowded with shipping from all parts of the known world. In 63 B.C., over 6000 talents (a million pounds sterling) were paid as port dues.[5] Dio

[1] Friedländer, ii, 185; Strabo, XVII, i, 8, 794C.

[2] Tarn, (1), 178 f.

[3] H. I. Bell, (2), (3); Bonnard, iii, 134 f., 170 f.; Botsford, (2), 397 f., 433 f.; E. Breccia, *Alexandrea ad Aegypten*, Bergamo, 1922; *id.*, and G. Stefani, arts. 'Alessandria', in *Ency. Ital.*, 1929, ii, 306, 319 (illustr.); A. Breccia, Il Porto d'Alessandria d'Egitto in *Mém. Soc. Roy. Géogr. d'Égypte*, Cairo, 1927, xiv; Brunet and Mieli, 329; Burckhardt, (1), 118 f., 168 f.; A. J. Butler, ch. viii, pp. 368 f.; D'Anville, *Mémoires sur l'Égypte Ancienne et Moderne*, 1766, 52–63; Deussen, (1), II, i, 462–515; Donne, DG, i, 95–102; V. Ehrenberg, Alexander und Ägypten, *Beih. a. O.*, 1926, vii, 1–59; E. M. Forster, *Alexandria, a History and Guide*, Alexandria, 1922, 2 ed. 1938; Friedländer, i, 28 f.; Humboldt, (4), ii, 536; C. Kingsley, *Alexandria and her Schools*, 1854; Legge, (1), i, 28 f.; Mahaffy, (1), 160 f.; Mead, (2), 96–120; Mommsen, v, 455, 489, 494, 571, 576–90, 617; Parthey, (1); Puchstein, PW, i, 1376–88; Quibell, chs. xii, xiii; Sandys, 1921, i, 105 f.; Schubart, (1); *id.*, (2) (literary activity 373 f.; trade 416 f. (bibl. 428 f.); life in Alexandria, 435 f.); *id.*, (3), 1 f., 379 f.; *id.*, 'Alexandria' in RAC, i, 271–83; Walsh, *Ann. Med. Hist.*, 1927, ix, 132; Windelband, (1), 210–62; A. M. de Zogheb, *Études sur l'ancienne Alexandrie*, 1909.

[4] Breasted, 462; Feldhaus, (1), 624; Quibell, 155; Schubart, (3), 5; Tarn, (1), 279.

[5] Diodoros Siculus, xvii, 52; Strabo, XVI, i, 7, 13, 792, 797C (12,500 talents).

Chrysostom, who saw the city in A.D. 69, says the population, besides Egyptians, Greeks, and Jews, included Italians, Syrians, Libyans, Cilicians, Ethiopians, Arabs, Bactrians, Persians, Scythians, and Indians.[1] After the discovery of the monsoons in the I cent. B.C. there was regular sea-traffic with India, and Indian merchants in Alexandria spoke Greek.[2] There were Arabs in the Fayyūm in the 3 cent. B.C.[3]

Until the Roman conquest in 30 B.C. Egypt was ruled by a succession of Ptolemies (I to XV) of Macedonian origin. Under Augustus (63 B.C.–A.D. 14) the city, second only to Rome, had a monopoly of Oriental trade, especially with India and Arabia.[4] Under Marcus Aurelius (A.D. 166) there was some contact with China.[5] The workers were specialists and rarely slaves; later work was by the Copts, who preserved old traditions and were very skilled.[6] Ancient Alexandria has disappeared; the Museum and Library have vanished and only the foundations of the Pharos remain. There was probably a subsidence in the Delta in the Middle Ages and much of the ancient city is now under water.[7] Alexandria in the Roman period produced metal work, pottery, glass, imitation gems, dyes, perfumery, eggs, honey, beer, ivory, linen, silk, paper, salted fish, alum, soda (natron), emeralds, and rubies: the Copts were the artisans and craftsmen, the Greeks the civil servant class.[8] Egypt was one of the oldest centres for the manufacture of glass. Alum was produced in Upper Egypt and Nubia, Khargah and Dâkhla; soda from lakes in the Wādī al-Naṭrūn near Memphis.[9] The technical arts in Alexandria were mostly developments of ancient Egyptian industries. The chief royal monopoly was olive oil; others were papyrus, mines, quarries, salt-works, natron pits, and perhaps fulling cloth.[10] Alexandria was famous for linen, its only serious rival being Borsippa.[11]

Flavius Vopiscus[12] quotes a letter (probably apocryphal) from the emperor Hadrian (A.D. 117–38) to Servianus describing his impressions of Alexandria (A.D. 130), 'ex libris Flegontis':

> 'Here no one is idle; some blow glass (*alii vitrum conflant*), others make papyrus, yet others weave linen. Everyone belongs to some trade and profession, even the gouty and the blind find something to do, and those whose hands are lame are not idle. . . . I send you iridescent vases of various colours (*calices allassontes* ⟨*di*⟩*versi coloris*) offered to me by the priest of the temple . . . take care that our Africanus does not break them.'

[1] *Orat.*, 32; Polybios, xxxiv, 14; Strabo, XVII, i, 12, 46, 797, 816C.; Donne, DG, i, 99; Friedländer, ii, 153; Schubart, (3), 47.

[2] Warmington, (1), 10, 36, 68, 75 f.

[3] Schubart, (3), 192.

[4] Friedländer, ii, 154; Schubart, (1), 47, 69.

[5] A. J. Butler, 112; Friedländer, ii, 155; iii, 82; Hirth, (3), 47, 69; Needham, (1), i, 198, 233; Schubart, (2), 420.

[6] A. J. Butler, 110 f., 168 f., 191, 279; Ruska, (3), 49.

[7] Quibell, 155.

[8] A. J. Butler, 106; Cumont, (5), 86 f.; Friedländer, ii, 83; iii, 82 f., 289; Rostovtzeff, (2), i, 362, 370, 374, 415; ii, 1212 f.; Schubart, (3), 52, 56 f.; Tarn, (1), 165 f., 220 f.; J. W. Thompson, 161 f.

[9] A. Lucas, (1), 118 f., 216; *id.*, *Analyst*, 1935, lx, 499; Partington, (1), 119–32, 144, 148; (4), 299; Rostovtzeff, (2), i, 300 f., 309, 370; Speter, *Glastechn. Ber.*, 1932, x, 647.

[10] Tarn, (1), 167, 174.

[11] Strabo, XVI, i, 7, 739C; Tarn, (1), 223.

[12] *Scriptores Historiæ Augustæ*, *Quadrigæ Tyrannorum*, viii, 1–10; ed. E. Hohl, 2 vols., Leipzig, Teubner, 1927, ii, 227–8; tr. in Menard, (1), lxix–xx; and Renan, (1), vi, 189; the work is now supposed to have been written in A.D. 362–3 as propaganda for Julian the Apostate; N. H. Baynes, *The Historia Augusta. Its Date and Purpose*, Oxford, 1926; Schehl; OCD, 431; it was formerly (and is still by some) thought to have been written between A.D. 284 and 337.

The Museum, probably founded by Ptolemy I but perhaps completed under Ptolemy II,[1] is briefly described by Strabo, who says it 'is part of the palaces. It has an open walk, a hall provided with seats (ἐξέδρα), and a large hall (οἶκος μέγας) in which the scholars of the Museum take their common meal. The scholars possess property in common, and a priest, formerly appointed by the kings but now by Cæsar, presides over the Museum'. 'Sport' was recognised; in Hadrian's time (2 cent. A.D.) athletes with no scholastic qualifications could become honorary fellows.[2] The main philosophical schools (Platonic, Aristotelian (the largest), Stoic, Epicurean, Cynic, and Sceptic) were all represented, and new schools, Neopythagorean and Neoplatonic, were founded in Alexandria. Jews and Christians, excluded from the Museum, had their own schools.[3] Besides its library the Museum had a botanic garden, a zoological collection, an observatory, and schools of medicine and anatomy.[4] The Museum and Serapeum, with their libraries, suffered under Caracalla (A.D. 211). Alexander Severus (A.D. 222–35) treated the city well, but under Aurelian (A.D. 272/3) the Museum was laid in ruins and the Library was probably broken up, part being perhaps transferred to the Serapeum, but the greater part destroyed. The Library of the Museum was very large; Budge says 400,000 to 700,000 books in the Ptolemaic period and 900,000 in Cæsar's time.[5] There was also in Roman times another library in the Serapeum. When it was destroyed the books perhaps went to Rome or Constantinople.[6] The burning of some books in the defence by Cæsar in 46/7 B.C. was probably unintentional; books were stored on the quay for export and these, when Cæsar set fire to the harbour shipping, accidentally caught fire; there was no library in the vicinity. Mark Antony is said to have given Cleopatra 200,000 books from the royal library at Pergamon to repair the loss.[7] The Alexandrian librarians were expert in literary criticism.[8] Some Egyptian works were translated into Greek.[9] Especially in the 3 and 4 cents. A.D. there was great activity in producing forged books.[10] Athenaios of Naukratis (fl. *c.* A.D. 200), whose *Deipnosophistai* (completed perhaps in Rome after A.D. 192 or even 228) in its present incomplete form (15 to 30 books) quotes some 800 authors, 700 otherwise unknown, and often mentions the Museum.[11]

[1] H. I. Bell, (2); Breasted, 468 f.; A. J. Butler, 407 f.; Fiehn, PW, xvi, 801; Geffcken, *Mélanges Bidez*, i, 407; J. F. Gronovius, De Museo Alexandrino diatribe, in J. Gronovius, *Thesavrvs Graecorvm Antiqvitatvm*, f°, Leyden, 1699, viii, cols. 2766–78; G. H. Klippel, *Ueber das Alexandrinischen Museum*, Göttingen, 1838; Mahaffy, (1), 193; (2), 69, 96; Matter, (1); J. G. Milne, (1), 55; Parthey, (1), 50 f., 94, 100, 203 f.; H. Poret, *École d'Alexandrie*, 1832 (pp. 38); B. Saint-Hilaire, (1); Schubart, (1), 29; (3), 103; Strabo, XVII, i, 8, 792–3C.; Susemihl, i, 7 f.; Tarn, (1), 155 f., 236 f.; *id.*, (5); Vacherot, (1); Weniger, *Das alexandrinische Museum*, 1875 (pp. 32).

[2] Parthey, (1), 94.

[3] J. Simon, (1), i, 182 f.

[4] Allbutt, 131 f.

[5] T. Birt, *Das antike Buchwesen*, 1882, 5, 485 f.; Budge, (7), viii, 192; Dziatzko, PW, iii, 405 (409), 939 f.; Parthey, (1), 64 f., 76 f.; F. Ritschl, *Die Alexandrinischen Bibliotheken*, Breslau, 1838, 21 f.; Susemihl, i, 335 f.

[6] Ebers, (1), 249; Parthey, (1), 64 f., 103; Susemihl, i, 336.

[7] E. Bevan, (2), 125, 364; Birt, 490; Budge, (7), viii, 115, 344; Parthey, (1), 32; Susemihl, i, 344; Tarn, (1), 237.

[8] Breasted, 473; Fabricius, B, (1) (*b*), iii, 814; Schubart, (3), 102 f.

[9] Otto, (1), 130.

[10] Bouché Leclercq, 598, 609; Mahaffy, (1), 487, 492–4, 514, 547; E. Meyer, (2), ii, 118 f.; E. H. F. Meyer, i, 225 f., 269 f.; Susemihl, ii, 579 f.; Wendland, 162.

[11] Parthey, (1), 151 f.

Paul Orosius (*c.* A.D. 417) found the shelves were mostly empty.[1] The legend concerning the burning of the library in the Arab conquest is discussed later. Subjects studied in the Museum included literature, mathematics, astronomy, law, philosophy, and medicine.[2] Galen[3] said physicians teaching anatomy 'gave opportunities for personal inspection' (i.e. of dissections), so that a medical student should make an effort to go there; skeletons were manufactured. The characteristic of the Hellenistic age has been described[4] as 'a failure of nerve' but this cannot be reconciled with its achievements. The names of Euclid, Apollonios of Perga, Diophantes, Heron, Archimedes, Aristarchos, Philo of Byzantium, and Ptolemy the astronomer, have a meaning in science. In pagan and Christian religion the schools of Alexandria were of supreme importance, and, as we shall see, chemistry arose there. The division of the Alexandrian period into early (to 200 B.C.), middle (200 B.C.–0), and late (to the complete decline of the school)[5] is meaningless.

When Ptolemy I faced the task of uniting the Egyptian and Greek elements of the population in Alexandria he decided that a new god, acceptable to both, was desirable. Osiris in old Egyptian texts is identified with a *dead* king, and became a god of the dead, represented by a mummy. In the 18 dyn. the priests of the god Ḥāpi (Apis) (a sacred bull) at Memphis declared that he was an incarnation of Osiris (Asar-Ḥāpi), and this is probably the origin of the name Sarapis (Σαρᾶπις) or Serapis (the Latin name), chosen by Ptolemy.[6] The statue of Sarapis in the Serapeum in Alexandria was a large seated figure with a bearded head of Zeus crowned with a *modius* (corn-measure).

Clement of Alexandria (A.D. 150–211/16)[7] says the image was made of gold, silver, bronze, iron, lead, tin, various gems, and lapis lazuli (or blue glass) (κύανος), forming a blackish colour, also the remains of the drugs used in embalming Osiris and Apis, all kneaded together (τῷ ἐκ τῆς Ὀσίριδος καὶ τοῦ Ἄπιος κηδείας ὑπολελειμμένῳ φαρμάκῳ φυράσας τὰ πάντα). The materials used were in sympathetic relation with gods and the idol was endowed with pneuma or became animate.[8] Rufinus (*c.* A.D. 345–410)[9] says the image was composed of all kinds of metals and woods and that in his

[1] *Hist. adv. Pagan.*, vi, 15; PL, 1846, xxxi, 1036 (421 H.). [2] A. J. Butler, 407 f.
[3] *De Anatom. Administr.*, i, 2; Kühn, ii, 220; Brock, 161.
[4] G. Murray, (1), 1925, 155. [5] Singer, (2), 56; cf. Parthey, (1), 216.
[6] Bonnet, 568, 649; Brady, OCD, 793; Budge, (i), ii, 113 f., 195; *id.*, (5), (6), 367; A. Erman, (1), 103, 384 f., 409; J. G. Frazer, *Adonis, Attis, Osiris*, 3 ed., 2 vols., 1914; H. Gressmann, (1), 34 f.; *id.*, Tod und Auferstehung des Osiris, *Alt. Or.*, 1923, xxiii, no. 3; Kaerst, ii, 242; K. Sethe, *Abhl. K. Ges. Wiss. Göttingen, phil.-hist. Kl.*, 1913, xiv, no. 5; *id.*, *Göttingen Gelehrte Anzeiger*, 1923, clxxxv, 106; *id.*, MGM, xv, 139; J. Vandier, *La Religion Égyptienne*, 1944, 152, 221 f.; Wiedemann, in Dieterich, (1), 34; Wilcken, *Urkunden der Ptolomäerzeit*, 1927, i, 18–37, 77 f., 92 f. For a supposed origin in Sinope (Black Sea region) see Reitzenstein, (7), 81, 100; Scott-Moncrieff, *J. Hellen. Stud.*, 1909, xxix, 79 (86); *id.*, (1), 20, 32; and for a Babylonian origin (Shar-Apsi), Lehmann-Haupt. Ro., iv, 338; *Z. Assyriol.*, 1897, xii, 112. See A. Abt, *A. Rel.*, 1915, xviii, 257–68; Ausfeld, 126; Burckhardt, (1), 170 f.; Jablonski, ii; 231–58; Kennedy, 96; Kraus, (2), 132; I. Lévy, *Rev. Hist. Relig.*, 1909, lx, 285; 1910, lxi, 162, 1911, lxiii, 125; 1913, lxviii, 308; Nock, (6); Parthey, (2), 213–17; E. Petersen, *A. Rel.*, 1910, xiii, 47–74; Roeder, PW, II Reihe, I, ii, 2394; Tarn, (1), 320; Waitz, Ro., iv, 378; Wilcken, *op. cit.* (full discussion); Wünsch, *A. Rel.*, 1911, xiv, 579.
[7] *Protrept.*, iv; Migne, PG, viii, 139; from Athenodoros.
[8] Hopfner, (1), 240–2; *id.*, PW, xiv, 349; Kraus, (2), 132.
[9] *Hist. Eccles.*, ii, 23; Migne, PL, xxi, 529.

temple a representation of the sun made of iron was kept suspended by a magnet. Others[1] said the image was made of various metals and woods, coloured dark blue, with jewelled eyes which flashed.

The Serapeum, on an artificial hill or acropolis, was a centre of heathen worship until A.D. 389 or 391, when, under a rescript of the Emperor Theodosios, the image of Serapis was destroyed, and the building became a Christian church. A legend says the image of Serapis was then found to be infested with mice.[2] Rufinus[3] says all kinds of clandestine activities (usum diversis ministeriis et clandestinis officiis exhibeant) and frauds were carried on in the vaulted cellars beneath the Serapeum. Ammianus Marcellinus[4] speaks of these, in which old magic ceremonies were carried out; the priests had foreseen the deluge (sunt et syringes subterranei . . . quos, ut fertur, periti rituum vetustorum adventare diluvium præscii). Berthelot[5] thought alchemy was studied.

Alexandria was 'the city of Aion' (*Αἰών*), the eternal city. The god Aion, mentioned by the poet Nonnos of Panopolis (fl. A.D. 440–90),[6] was derived by Reitzenstein and by Stegemann from the Iranian god of infinite time Zurvān and identified, as *Αἰών Πλουτώνιος*, with Sarapis,[7] but he may represent Kronos.[8] Since Alexander was buried there, Alexandria was regarded as eternal. At the time of its foundation, legend said, a great snake appeared, *'Αγαθὸς δαίμων*, which on Alexander's order was killed and buried, and became *Αἰών Πλουτώνιος*; a great number of small snakes appeared which, on the advice of a soothsayer, were worshipped in the houses as *'Αγαθοὶ δαίμονες*.[9] Aion included all space and time and Sarapis is said to be 'a statue reaching from heaven to earth' (the Tower of Babel).[10] In gnostic literature and on gems Aion appears as *'Ιαὼ Σαβαώθ 'Αβρασαξ*, etc., and as a serpent biting its tail (*'Αγαθὸς δαίμων = Οὐροβόρος*), 'serpent-formed Aion, Lord Sarapis'.[11] In a Middle Turkish Manichaean text Äzrua (= Zurvān = Aion ?) is clothed in the five 'bright elements', breath, wind, light, water, and fire, and the idea may be of Indian origin.[12] The Iranian origin of Aion is not accepted by some.[13] In the Ptolemaic period the Egyptian priesthood was still

[1] Chwolsohn, ii, 685; cf. Pliny, xxxvii, 17 (4); a marble lion with emerald eyes in Cyprus.

[2] Besant, DCB, iii, 1000; A. J. Butler, 380 f., 410 f.; Donne, DCB, i, 98; Eunapios, (1) 422; Parthey, (1), 101 f.; Theodoretos (A.D. 393–457/8), *Hist. Eccles.*, v, 21, ed. Parmentier and Schweidler, Berlin, 1854, 321.

[3] *Hist. Eccles.*, iii, 21, 26; Migne, PL, xxi, 529 f., 554.

[4] xxii, 15, § 30.

[5] (1), 196.

[6] *Dionysiaka*, vi, 372; Friedländer, *Hermes*, 1912, xlvii, 43.

[7] Dion Chrysostom, *Orat.*, 32; Glover, (1), 133, 155; H. Junker, Iranische Quellen der hellenistischen Aion Vorstellung, *Vortr. Bibl. Warburg*, 1921–2, Leipzig, 1923; Reitzenstein, (5), 171 f., 188 f., 213, 229 f.; (7), 81, 100, 353; (12), 352 f.; Stegemann, 26 f., 200 f., 224 f.; Troje, *A. Rel.*, 1923, xxii, 87 (Indian parallels; Buonaiuti, 62 f., and de Faye, 57 f., thought *αἰών* is from the Sanskrit *ayu*, life); Weinreich, *A. Rel.*, 1918, xix, 174.

[8] Gressmann, (1), 146 f.; A. D. Nock, A Vision of Mandulis Aion, *Harvard Theol. Rev.*, 1934, xxvii, 53–104 (Mandulis, Egyptian Merul, a sun-god of Talmis, Egypt); Zepf, *A. Rel.*, 1927, xxv, 225.

[9] Reitzenstein, (5), 188 f.

[10] Kaerst, ii, 240 f., 364; Reitzenstein, (5), 176, 207 f., 211, 213 f., 218 f.; (7), 81, 100.

[11] Gressmann, (2), 24; Kaerst, ii, 241; Reitzenstein, (5), 85, 191.

[12] Reitzenstein, (5), 41; (7), 92.

[13] Dodds, (1), 227; Festugière, (1), iv, 146 f., 152 f. (A. in Hermetic texts), 176 f. (A. outside Hermetic texts); Lackeit, PW, Suppl. iii, 64; Zepf, *A. Rel.*, 1927, xxv, 225 (a typical repr-sentative of the gnostic syncretistic movement).

very wealthy. The hieroglyphic inscriptions, at first set up freely, now became secret knowledge, and the ceremonial of the various cults was inscribed in great detail on the temple walls.[1] By about A.D. 200 the priests were still confined to a certain caste; as late as A.D. 250 a few had some knowledge of hieroglyphics. The legend that philosophy came from the East had begun under Plato in the Academy;[2] with the conquests of Alexander interest in Oriental ideas was aroused. They were 'rationalised' and the myth of the deep and obscure wisdom of the East grew up. After the destruction of the Serapeum in A.D. 389 such studies were apparently pursued in secret.[3]

JEWISH-HELLENISTIC PHILOSOPHY

There was a colony of polytheistic Jews in the 5 cent. B.C. at Elephantine in Egypt.[4] Jewish colonies in Asia Minor were influenced by Phrygian religious ideas and Chaldaean astrology.[5] Under the first three Ptolemies the Jews in Egypt, especially in Alexandria, formed a large part of the population;[6] they lived in a separate quarter and were probably not full citizens, although they participated freely in the life of the city.[1]

Jewish history first became known to the Greeks through Josephus (A.D. 37/8–c. 100).[8] Most Alexandrian Jews were ignorant of Hebrew and spoke Greek, so that a Greek version of the Old Testament, the *Septuagint* (LXX), was made piecemeal from about 250 to 132 B.C.[9]

Early Jewish literature in Greek was mostly intended to prove that the Greeks had borrowed from Jewish authors from Moses downwards; Plato was 'Moses speaking Greek' and Egyptian learning also came from Moses, who invented weapons, machines, ships, and philosophy; he was the same as the Egyptian Thoth or Hermes Trismegistos.[10] Aristoboulos (*c.* 150 B.C.) used forged Greek works and treated the Old Testament as allegory.[11] Such ideas occur in the *Wisdom of Solomon* (see p. 177), in the *Fourth Book of Maccabees* (*c.* 100 B.C. or later),[12] and in the *Sibylline Oracles*, the oldest part (bk. iii) of which may go back to *c.* 140 B.C., bk. iv to *c.* A.D. 80, and the rest (12 of the 30 books are known) to the 3 cent. A.D.[13]

[1] Bell, (4), 54 f.; Budge, (2), 104 f. [2] Festugière, (1), i, 19–44.
[3] Hopfner, PW, xvi, 1315 f., 1319; Pieper, *ib.*, 2160 (Nechepso), 2234 (Nektanebos).
[4] E. Meyer, (3).
[5] Anrich, 75 f., 81; Eisele, Ro., iv, 257; Kennedy, 58.
[6] Tarn, (1), 181–208; Zeller, III, ii[4], 264 f.
[7] Barth, 253; H. I. Bell, (1), (2), (3), 36 f.; Tarn, (1), 184.
[8] Tarn, (1), 1947, 181–208.
[9] Bell, (4), 44; Bigg, 5; Deussen, (1), II, i, 463; Eissfeldt, PW, xix, 513; Hautsch, PW, II Reihe, ii, 1586; Hody, (1), 133 (q. the alchemist Zosimos, *c.* A.D. 250); Kautzsch, ii, 1 f.
[10] Deussen, (1), II, i, 465, 481; Dornseiff, 7; Hopfner, *Beih. a. O.*, 1925, iv, 51 f.; Legge, (1), i, 173; E. Meyer, (2), ii, 361; Puech, *Mélanges Bidez*, ii, 745; Reitzenstein, (5), 102; Stählin, in Christ, 1920, II, i, 435 f.; Tarn, (1), 204 f.; Zeller, (1), III, ii[4], 261 f.
[11] Works attributed to him may be forgeries of the 3 cent. A.D.: Gercke, PW, ii, 918; Zeller, (1), III, ii[4], 277.
[12] Drummond, i, 168; Kautzsch, ii, 149; Zeller, (1), III, ii[4], 297.
[13] Text, ed. C. Alexandre, Paris, 1869 (with Latin tr.); J. H. Friedlieb, *Oracula Sybillina*, Leipzig, 1852 (with German tr.), and *Supplement* by R. Volkmann, Leipzig, 1853; J. Geffcken, in GCS, 1902; trs. in Charles, (1), ii, 368; Kautzsch, ii, 177 (incompl.); see Buchholz, Ro., iv, 790; Drummond, i, 169; Hausrath, (2), i, 111; Lupton, DCB, iv, 644; E. Meyer, (2), ii, 355; Rzach, PW, II Reihe, ii, 2117; Seelinger, Ro., vi, 413; Stählin, in Christ, 1920, II, i, 463;

A Jewish-Alexandrian 'philosophy' developing from the 2 cent. B.C. to Philo is a fable.[1] Jewish ideas which influenced contemporary and later thought were those of the seven heavens and seven classes of angels, and the Jewish names of the seven planets and the planetary demons.[2] Greek influence on the extensive Jewish literature from the 3 cent. B.C. is perhaps less than has been assumed,[3] but Iranian influence is certain.[4]

The Book of Enoch

Of the apocrypha and pseudepigrapha of the Old Testament the most interesting from our point of view is that attributed to Enoch, which exists in two forms, Enoch I (Ethiopic, and fragments in Greek) and Enoch II (Slavonic). In the Old Testament (*Genesis*, v, 18 f.), he lived before the Flood and 'walked with God';[5] he was regarded by Jews as an ancient prophet, the discoverer of occult science, and a revealer of mysteries of the past and the future.

The original of Enoch I was probably written in Hebrew or Aramaic, or both, in North Palestine, using material over the period 167–64 B.C. from several sources. It was translated in Egypt into Greek in the 1–2 cents. A.D., and from Greek into Ethiopic about A.D. 500–600.[6] It is quoted below by chapter. Fragments of the Greek version are quoted by Synkellos (*c.* A.D. 800)[7], probably from Panodoros of Alexandria (*c.* A.D. 400), and by Scaliger.[8] A Greek fragment on parchment (now dated 6 or end of 5 cent.) was found at Ikhmîm (old Panopolis, now Gizeh).[9] The end of the Greek text is contained in papyrus found in Egypt.[10] The *Book of Enoch* is mentioned by Jude (14–15)[11] and Eusebios[12] from Eupolemos (*c.* 150 B.C.). The so-called *Noachian Fragments* or the *Apocalypse of Noah* (chs. vi–xi) are supposed to be part of a Jewish gnostic literature circulating under the name of Enoch.[13]

The *Book of Enoch*, which Beer called 'the beginning of Jewish gnosis', contains Babylonian and Persian elements. Enoch had acquired the reputation of a teacher of secret wisdom in the 2 cent. B.C.[14] and for the Arabs later he was regarded as the same as Hermes Trismegistos.[15]

Josephus[16] says the descendants of Seth, son of Adam, afterwards identified with Enoch, engraved their wisdom (astrology) on a pillar of brick (which

J. Thomas, 46; Zeller, (1), III, ii[4], 290; for the anagram in bk. i, lines 141–5, see Vol. II, 12, 315.

[1] E. Meyer, (2), ii, 361 f.; P. Wendland, 201 f.; *id.*, in JE, i, 368; Zeller, (1), III, ii[4], 261 f.

[2] Bousset, *A. Rel.*, 1901, iv, 268; Roscher and Boll, Ro., iii, 2519 f.

[3] Tarn, (1), 181–208.

[4] G. Beer, in Kautzsch, ii, 122; Wesendonk, (1), 83 f.

[5] Beer, in Kautzsch, ii, 217: of non-Israelitish origin.

[6] Tr. by R. H. Charles, ii, 163–281; *id.*, (2); tr. G. Beer, in Kautzsch, ii, 217–310.

[7] (2), 1829, i, 21 f.

[8] *Eusebii Chronicorum Canonum*, Leyden, 1606, *Animadversiones*, 243 f.; Fabricius, (2), 1713, i, 179, 183; Festugière, (1), III, ccxv f.; Tarn, (1), 202 (earliest part of Enoch I 200–170 B.C.).

[9] A. Lods, *Le Livre d'Henoch*; *Fragments grecs découverts à Akhmîm*, 1892; Charles, (2), 318 f.

[10] *The Chester Beatty Biblical Papyri*, ed. F. G. Kenyon, 1933, Fasc. i, 9, plate XII; C. Bonner and H. C. Youtie, *The Last Chapters of Enoch in Greek*, in *Studies and Documents*, ed. K. and S. Lake, viii (incl. part of papyrus in Michigan), 1937; O'Leary, *J. Egypt. Archaeol.*, 1932, xviii, 181.

[11] H. J. Lawlor, *J. Philol.*, 1897, xxv, 164–225.

[12] *Praepar. Evang.*, ix, 17; ed. Gaisford, Oxford, 1843, ii, 370 f.; Charles, (2), 33.

[13] Littmann, in Brockelmann, (2), 187, 227.

[14] Dieterich, (2), 206. [15] Reitzenstein, (2), 173. [16] *Antiq.*, I, ii, 3.

would endure fire) and a pillar of stone (which would survive the Flood); a third pillar was standing in his time. Enoch, 'the seventh after Adam', engraved his wisdom on tablets of stone, discovered on a mountain and taken to Jerusalem.[1]

According to Enoch[2] various kinds of evil knowledge were revealed to women by fallen angels, a story based on *Genesis* (vi, 1, 4), and ψ-Clement[3] reports that the bones of giants, their descendants, were found. Charles traces it to an early Persian myth. Enoch says two hundred angels descended and took wives, whom they taught magic methods (*φαρμακείας*) and enchantments (formulae) (*ἐπαοιδάς*), the cutting of roots (*ῥιζιοτομίας*) and (medicinal) plants, making swords, knives, shields and coats of mail, metals and the art of working them, arm-bands and ornaments (amulets), eye-paints for ornamenting the eyelids (*στίβεις καὶ τὸ καλλιβλέφαρον*), all kinds of precious stones, and all kinds of colours (*βαφικά*), astrology, astronomy, divination, and the signs of the earth, sun, and moon. This caused great disturbance and the cries of men reached to heaven and annoyed the archangels. Another account (lxv–lxix) adds knowledge of the secrets of the angels and Satan, and all concealed forces, formulae, making cast idols ('molten images' in the Bible), murderous weapons, how silver is made from dust of the earth, how soft metal arises in the earth, how tin and lead are won from a spring with an angel in it, and writing on paper with ink. All this is sinful knowledge. Enoch saw a burning valley with mountains of gold, silver, iron, soft metal, and tin; fiery liquid metals, moving waters, and hot waters (due to the immersion of angels) with a smell of sulphur.

The *ἐγρήγοροι* (*egregoroi*, watchers) of Synkellos were the guardian angels of men, mentioned by ψ-Clement;[4] in *The Book of Jubilees* (135–105 B.C.) (viii, 3)[5] they wrote about astrology on stones. The *καλλιβλέφαρον* (*calliblepharum tincturae*) means painting the eyelids black with stibium (*καλός*, beautiful; *βλέφαρον*, eyelids). The word is used by Pliny[6] for a black made from charred rose-petals,[7] and for a collyrium in Marcellus Empiricus.[8] In another account (Enoch, xxiv, xxxii) there are, in the ends of the earth seven burning mountains, seven mountains of precious stones, and seven mountains of spices in the East. Plutarch[9] says Thespesios in a vision saw in Hades lakes of boiling gold, exceedingly cold lead, and most rough iron, into which the souls of the wicked were plunged by demons like metal-founders, with tools.

In Enoch there are (xli) chambers of hail, winds, clouds, mist, sun and moon, and (lx) angels or spirits of hoar-frost, dew, hail, and snow. The stars are personified, are capable of sin (xviii, xxi, xc), and are punished. The idea

[1] Festugière, (1), i, 334, from CCAG; the legend influenced Christian and Muḥammadan traditions.
[2] Charles, (1), ii, 191; (2), 64; Synkellos, (1), 13; Lods, 11, 73.
[3] *Recog.*, i, 29. [4] *Homil.* viii, 12. [5] Kautzsch, ii, 55; Hammer Jensen, (1), 120.
[6] xxi, 73 (19); xxiii, 51 (4); xxxiii, 34 (6).
[7] W. Smith, (4), 143; charred vine-leaves; the word is not in the index of Salmasius, (1).
[8] *De Medicamentis*, c. viii, in *Med. Art. Princ.*, 281.
[9] *De Sera numinis vindicta*, c. 22; *Moralia*, Paris, 1841, i, 685; J. A. Stewart, (1), 375.

that human sin upsets the course of nature, the period of the moon, and the courses of the stars (lxxx)[1], reappears in Apollonios of Tyana (1 cent. A.D.)[2] and in ψ-Clement,[3] where pestilences are caused by the air being disturbed or vitiated by them; the sun glows more fiercely, and the elements are wearied by them, producing excess of rain or cold. Enoch (liv, 8; lx, 7–8) says the water above the firmament and Behemoth are male, the water below the firmament and Leviathan are female.

The legend of the fallen angels occurs in many other authors.[4] Tertullian[5] quotes both passages from Enoch (ut Enoch refert), giving the secrets of metals (operta metallorum), the forces of plants (ingenia herbarum), spells (vires incantationum), interpretation of the stars (stellarum interpretationum), making arm-bands of gold and necklaces of jewels, dyeing wool with archil (tincturae vellerum; medicamenta ex fuco), black eyelid-paint (calliblepharum tincturae), works (opera) with gold and gems, and all kinds of arts and curiosities. Tertullian also[6] mentions colouring drugs (pigmenta medicinalia). Women should be veiled, lest they cause more angels to fall.[7] If God had intended us to wear purple clothes he would have created purple sheep.[8] In St. Cyprian (A.D. 200–258), painting, cosmetics, and hair-dye are inventions of the Devil; women using them 'will burn by and by'.[9] The mention of 'work with metals and stones' and dyes is reminiscent of the Leyden and Stockholm Papyri (see p. 214),[10] and Zosimos added alchemy to the arts taught by fallen angels.[11]

In ψ-Clement[12] the fallen angels show their mistresses the marrow of the earth (τῆς γῆς μυελοὺς ὑπέδειξαν), viz. the choicest metals (ἐκ μετάλλων ἄνθη), gold, copper, silver, iron, and the like precious things, with all the most precious stones (τοῖς τιμιωτάτοις λίθοις). And with the charmed stones (μαγευθεῖσιν λίθοις) they delivered the arts (τέχνας) of the things pertaining to each, gave knowledge of magic, taught astronomy and the powers of roots, melting of gold and silver and the like (δὲ χρυσοῦ καὶ αργύρου καὶ τῶν ὁμοίων χύσιν), and dyeing. Afterwards[13] men knew the names of angels and cured

[1] Charles, (2), 32. [2] Philostratos, iii, 34. [3] *Recog.*, v, 27; viii, 45–7.

[4] Summary in Charles, (2), 62; Fabricius, (2), 1713, i, 168 f.; Lawlor, *J. Philol.*, 1897, xxv, 164; W. Scott, (1), 1936, IV, xxv; e.g. Josephus, *Ant.* I, i, 3 (fathers of giants); Justin Martyr (A.D. 150), *Apology*, i, 5 (Migne, PL, vi, 335); Athenagoras of Athens (A.D. 177), *Legatio (Supplicatio) pro Christianos*, c. 22 (ed. Paul, Halle, 1856, 86); Clement of Alexandria (d. A.D. 216), *Paedagogi*, iii, 2 (ANL, i, 238); *Stromata*, vi, 1 (ANL, 226); Lactantius (4 cent. A.D.), *Institutions*, ii, 15 (Migne, PL, vi, 331; Hermes is mentioned); Tertullian (A.D. 160–240), *De Cultu Feminarum*, i, 2; ii, 11 (Migne, PL, i, 1305, 1328; Charles, (2), 66); Irenaeus (A.D. 180), *Proof of the Apostolic Announcement*, known only in Armenian (in TU, 1907, xxxi, 10); Commodianus (A.D. 250), *Instructiones adversus Gentium Deos*, i, 3 (Migne, PL, v, 205); Augustine, *Civ. Dei*, xv, 22–23; the Ethiopic ψ-Kallisthenes, in Budge, (8), 315, 457 (the place is Alexandria); and the *Qabbalah* (Karppe, 97; Waite, (1), 85); for the alchemist Zosimos (*c.* A.D. 250).

[5] *De Cultu feminarum*, i, 2; ii, 10–11.

[6] *De Idolat.* 11; Migne, PL, i, 676, and note saying they are in Firmicus Maternus and Cassianus.

[7] *De Oratione*, 22. [8] *De Cultu feminarum*, i, 8.

[9] *De Habitu Virginum*, ANL, viii, 345. [10] Berthelot, (1), 12.

[11] Part of the Greek text of Enoch in Synkellos is given (from Scaliger) by Borrichius, (1), 13, and all of it by Fabricius, (2), 1713, i, 179 (adds quotation from Zosimos, 183); Hoffmann in Ladenburg, (1), ii, 517; Kopp, (2), i, 6; E. Meyer, (2), ii, 54 (Ikhmim text).

[12] *Homil.* viii, 14; ed. Dressel, Göttingen, 1853, 188 f.; ANL, xvii, 143.

[13] *Homil.* iii, 36; Dressel, 97.

diseases by medicines (φάρμακα), sympathies and antipathies, etc. The angels transform (μετέβαλλον) *themselves* into gems, pearl, purple (πορφύρα), choice gold, beasts, birds, fishes and reptiles.[1] Although two hundred angels fell, the first account in Enoch names only nine, and the second twenty-one; Azāzēl taught the useful arts, Semjāzā (or Amezarek) magic formulae, Baraqel astrology, Cocabel astronomical signs, Gadreel implements of war, Penemon the art of writing, and Kesbeel the secret name of God.

The *Qur'ān* says they were Babylonian; Muhammad names two, Mārūt (from Syrian and Persian accounts) and Hārūt (added arbitrarily).[2] In Al-Qazwīnī (13 cent., using al-Jāḥiẓ and al-Mas'ūdī, 9–10 cents.) the evil spirits (Marīt) ensnared by women were compelled by Solomon to work in mines, smelt iron and bronze, make glass and gems, and fish for pearls.[3]

Enoch II or *The Book of the Secrets of Enoch*, known only in a Slavonic version made from a Greek original composed on the basis of Enoch I by a Hellenistic Jew in Alexandria about A.D. 1–50,[4] gives the first detailed Jewish account of an ascent (of Enoch) through the seven planetary spheres,[5] although the Essenes knew of it.[6] In the third sphere Enoch saw the tree of life with gold and vermilion colours; in the fourth, the sun and moon, phoenixes,[7] and *chalkhydri* (χαλκύδραι) or bronze serpents with lion's feet and tail, crocodile's head, and twelve wings, all singing when the sun appears through twelve gates (leaving through twelve others). In the fifth sphere were the giants (*grigori*) or satans, three of whom went down to earth to take wives from the daughters of men and begat giants. In the seventh sphere Enoch saw God, and wrote 360 or 366 books on the secrets of the creation, which he took back to the earth but kept secret. In the sixth heaven were angels of the planets, of rivers, the sea, the fruits of the earth, and one over every herb (ch. xix). God created the world either from nothing or from pre-existing elements, Adoil, by divine command, bursting asunder and emitting 'a great stone, bearing all creation' (chs. xxiv–xxx).

A Hebrew so-called *Enoch III*[8] is a composite, work, with no obvious relation to Enoch, found in a 16-cent. MS. An Aramaic Enoch found among the Dead Sea scrolls (see p. 178) was regarded by Albright as part of the lost book of Lamech (in the Bible the fifth lineal descendant from Cain).[9]

Astronomical apocalypses first appear in Jewish literature in Enoch; they have been traced to Greek (Orphic)[10] or Iranian[11] influence. The idea of the ascent of heroes and spirits to higher spheres goes back to old Greek philo-

[1] *Homil.* viii, 12.
[2] Horovitz, (1), 81, 101, 146; Littmann, *Festschrift für F. C. Andreas*, 1916, 70, 85; Noldeke, *Islam*, 1922, xii, 112; O. Rescher, *Islam*, 1919, ix, 1; Wensinck, *Ency. Islam*, ii, 272.
[3] Ansbacher, *Diss.* Kirchhain, 1905, q. by Lippmann, (2), i, 311.
[4] W. R. Morfil and R. H. Charles, *The Book of the Secrets of Enoch*, Oxford, 1893; Bonwetsch, Das Slawische Henochbuch, *Abhl. Ges. Wiss. Göttingen, phil.-hist. Kl.*, 1896, i, no. 3; Charles, (1), ii, 425–69.
[5] Charles, (1), ii, 432 f.
[6] Bousset, *A. Rel.*, 1901, iv, 138 f.
[7] The only reference to more than one phoenix at a time, Charles, (1), ii, 528, 537.
[8] Odeberg (1); *Isis*, 1929, xiii, 219; Gaster, JRAS, 1929, 201.
[9] Dodd, (2), 242.
[10] Stewart, (1), 361 f., 455.
[11] Reitzenstein, (5), 123, 141.

sophy, e.g. Parmenides (*c.* 475 B.C.) and was well known.[1] In Plutarch[2] Thespesios in a vision sees souls rising through the planetary spheres as fiery bubbles of different colours, which burst and disclosed the souls; these were the intellectual part of the soul, the rest being left anchored to the body.

The *Fourth Book of Ezra* (50–30 B.C., revised A.D. 90–120)[3] says (vii, 52) God created gold, silver, and bronze, and less valuable iron, lead, and clay (in this order); it describes (xiii, 10) a man from whose mouth came fire, smoke, and sparks, perhaps an Iranian myth.[4]

The Greek *Apocalypse of Baruch* (*III Baruch*) (different from the Syriac *II Baruch*) composed *c.* A.D. 136, described an ascent through five heavens, the other two (Origen says there were seven) being missing in the ms.,[5] and the mediation of angels, previously only hinted. Angels as a distinct group of beings (at first seven) appear in the *Book of Tobit* (xii, 15), composed in Greek in Egypt *c.* 250 (or 175–25) B.C., probably under Iranian influence (it mentions the demon Asmodeus = Aeshmā Daevā), the original being perhaps Aramaic.[6] A plurality of heavens appears in the Old and New Testaments, and in Rabbinical, Babylonian, Persian, Greek, and early Christian accounts; seven appear regularly in the 1 cent. A.D.[7] It says good angels set over wind, frost, heat, cold, etc., taught medicine to Noah, which he wrote in a book.[8]

The *Testament of the Twelve Patriarchs* (109–106 B.C. but interpolated) speaks of three and later of seven heavens;[9] it refers to the *Book of Enoch*. Seven heavens are given in *The Martyrdom of Isaiah* (1 cent. A.D.) and *The Life of Adam and Eve* (1–2 cents. A.D.).[10] *The Wisdom of Solomon* (one part 50–30 B.C., another 30 B.C.–A.D. 10)[11] shows Iranian influence and makes Solomon a great magician, as in Josephus[12] and the magic papyri. It includes astrology (the stars are στοιχεῖα), the operation or change (μεταβολή) of the elements, and 'all things secret or manifest'. In the gnostic *Odes of Solomon*[13] (50 B.C.–A.D. 67 with Christian revision after A.D. 100)[14] the world has upper and lower parts with created things in the middle. Things below (τὰ κάτω) in dark chaos can rise to higher regions (τὰ ἄνω) of light.

[1] Capelle, *A. Rel.*, 1927, xxv, 250; cf. the 'way up and the way down' in Herakleitos.
[2] *De sera numinis vindicta*, c. 22; *Moralia*, Paris, 1841, i, 685; Stewart, (1), 368.
[3] Charles, (1), ii, 542; Kautzsch, ii, 331; Appel, *A. Rel.*, xv, 254.
[4] Reitzenstein, (5), 121.
[5] Charles, (1), ii, 526; Kautzsch, ii, 446.
[6] Charles, (1), i, 174, 188 (earliest 350 B.C., latest 170 B.C.); Kautzsch, i, 145; Barnes, in A. S. Peake, 306.
[7] Charles, (1), ii, 530, 563. The story of the ascent of Muḥammad is probably based on Jewish or Christian sources: Bousset, *A. Rel.* 1901, iv, 249; B. Schrieke, *Islam*, 1916, vi, 1.
[8] x, 10; Charles, (1), ii, 1 f., 28; Hausrath, (1), i, 128.
[9] Charles, (1), ii, 282 f., 304 f., 530 f., 563.
[10] Charles, (1), ii, 123, 155.
[11] Charles, (1), i, 518 f., 527, 532, 556, 562 f.; Deussen, (1), II, i, 466; Drummond, i, 177; Kautzsch, i, 476; E. Meyer, (2), ii, 358 f.; Rescher, *Islam*, x, 1(49); Reitzenstein, (5), 240; Zeller, (1), III, ii^4, 271.
[12] *Ant.* VIII, ii, 5.
[13] Harnack, Ein judisch-christliches Psalmbuch, TU, 1910, xxxv, no. 4.
[14] Kittel, *Die Oden Salomos*, Leipzig, 1914; Buonaiuti, 70.

The Essenes

The Essenes (*'Εσσαῖοι* Philo; *'Εσσηνοί* Josephus; the name has been derived from Hebrew *Chaššaîm*, silent; Aramaic *Chasaija*, pious; or *sacha*, bathers or baptists; or Syriac *asja* (*asaya*) or Babylonian *asu*, physician),[1] an ascetic community of about four thousand, lived in Palestine from about 150 B.C. to A.D. 132.[2] Hebrew scrolls in jars found at Qumrân near the Dead Sea (where Pliny[3] said there was a community of Esseni) may throw some light on them.[4]

The Essenes were probably a sect of Jews who migrated from Mesopotamia to Palestine after the victory of Maccabees (164 B.C.); their Babylonian origin explains their interest in the virtues of plants and stones, on which Berossos is said to have written.[5] Greek philosophical, Indian, and Iranian influences have been discounted,[6] but[7] Neopythagorean teachings probably reached Syria and Palestine from Alexandria from about 150 B.C. and the philosophical and medical knowledge of the Essenes was of Greek, not Jewish, origin. Josephus[8] says of the Essenes:

> 'They also take great pains in studying the writings of the ancients and choose out of them what is most for the advantage of their soul and body; and they inquire after such roots and medicinal stones as may cure their diseases. (*ἔνθεν αὐτοῖς πρὸς θεραπείαν παθῶν ῥίζαι τ' ἀλεξητήριοι καὶ λίθων ἰδιότητες ἀνερευνῶνται.*')

They swore not to reveal their doctrines, or their books, or the names of the angels, to outsiders. Bodies are corruptible but souls, which come out of the most subtle air and are imprisoned in bodies, are immortal and when set free mount upwards; which, says Josephus, is 'like the opinion of the Greeks'. Hippolytos[9] says the Essenes 'are very curious concerning plants and stones (*περὶ βοτάνας καὶ λίθους*), being very inquisitive as to their operation (*πρὸς τὰς τούτων ἐνεργείας*), as they think that these did not come into being in vain (*μὴ μάτην ταῦτα γεγονέναι*)'. A relation with alchemy has been assumed.[10]

The Therapeutae, described only by Philo Judaeus (*c*. A.D. 22–3), were a religious community living near Alexandria, interested in Neopythagorean number mysticism, e.g. the number 7, and the fiftieth (Jubilee) year, perhaps derived from the sides (3 : 4 : 5) of a right-angled triangle ($3^2+4^2+5^2=50$). Their relation to the Essenes is doubtful.[11]

[1] Dieterich, (1), 143; Ginsburg, DCB, ii, 207; Kohler, JE, v, 224; Lewy, *E. Jud.*, 1930, vi, 795; E. Meyer, (2), ii, 393; S. Munk, 468; Reitzenstein, (3), 45; Zeller, III, ii⁴, 308.

[2] Legge, (1), i, 149 f., 168, 170.

[3] v, 15.

[4] M. Burrows, *The Dead Sea Scrolls*, New York, 1955, 272 f.; F. M. Cross, *The Ancient Library at Qumrân and Modern Biblical Studies*, 1958; E. Wilson, *The Scrolls from the Dead Sea*, 1955, 36 f., 72 f.

[5] Albright, 288 f.; J. Thomas, 4 f., 22 f.

[6] Baeumker, 389–402; Bauer, PW, Suppl. iv, 428; P. E. Lucius, *Der Essenismus*, Strasbourg, 1881; Ueberweg, (1), i, 513.

[7] E. Meyer, (2), ii, 393 f.; Wellmann, (4), 8, 16; (5), 67; Zeller, (1), III, ii⁴, 365 f.

[8] *Wars*, II, viii, 6 f.

[9] *Refut.*, ix, 18–27 (22–3); Legge, (2), ii, 138 (141).

[10] J. W. Brown, 32 f., 70.

[11] F. C. Conybeare, *Philo about the Contemplative Life*, Oxford, 1892 (Philo's work is genuine); Dieterich, (1), 145 f. (Orphic ideas); Deussen, (1), II, i, 464; Edersheim, DCB, iv, 361, 369; Kohler, JE, xii, 138; Mead, (2), 61 f., 65 f.; E. Meyer, (2), ii, 368; Wendland, JE i, 368; Zeller, III, ii⁴, 374, 377.

PHILO JUDAEUS

Philo (*Φίλων*) of Alexandria (Philo Judaeus) (*c.* 30 or 20 B.C.–*c.* A.D. 50), a member of a distinguished Jewish family in Alexandria, had a sound education in Greek philosophy, and attempted to reconcile it with the Old Testament *Septuagint* (he probably had little or no knowledge of Hebrew), on the assumption that this had a double meaning, a literal and an allegorical, both equally true. He represented the Jewish community on a deputation to the Emperor Gaius in Rome in A.D. 39–40.[1] Most of his works probably date before A.D. 38;[2] some printed in his works are spurious.[3] In Philo the Stoic use of allegory reached absurd limits in attempts to find concealed meanings in the Bible.[4] He interpreted Jacob's ladder as the air into which evaporations from the earth dissolve,[5] and the tree of knowledge is not a real tree growing in Paradise but the soul ruling the senses.[6] Atoms do not exist because the Bible says: 'he divided them in the midst.'[7] Philo is a good source for Stoic doctrines.[8]

Matter for Philo, as in Plato's *Timaios* (see p. 53), is being without specific form or qualities (*ἄμορφος, ἄποιος*), indefinite (*ἄπειρος*) and lifeless (*νεκρόν*), but capable of becoming anything. It is more like the Stoic *οὐσία* or 'body' (*σῶμα*) than the Aristotelian primary matter *ὕλη*. Philo usually regarded material things not as created but an arrangement of chaos. Edersheim and Inge say that he regarded matter as essentially evil (before the Neoplatonists); Drummond did not accept this for Philo's authentic works. Philo gives a long list of 'opposites', which he says Herakleitos borrowed from Moses (they are really Pythagorean). The four elements (*στοῖχεια*), also called foundations, principles, or roots (*ῥίζα*), are (as with the Stoics) divided into fine (fire and air, hot and cold; he followed the Stoics in regarding air as cold) and coarse (water and earth, moist and dry); in the *Questions and Solutions* (known only in Armenian and doubtfully authentic) the elements have the forms of

[1] Baeumker, 380; Barth, 254; T. H. Billings, *The Platonism of Philo Judaeus*, Chicago, 1919 Brandis, DBM, iii, 310; E. Bréhier, *Les Idées philosophique et religieuse de Philon d'Alexandrie* 1908 (2 ed. 1925); J. Daniélou, *Philon d'Alexandrie*, 1958; Deussen, (1), II, i, 462; Dodd, (2), 54–73; J. Drummond, 1888; Edersheim, DCB, iv, 357–89; T. R. Glover, 88, 101; E. R. Goodenough, *The Politics of Philo Judaeus*, New Haven, 1938 (bibl. by E. R. Goodenough and H. L. Goodhart, 127–321); *id.*, *An Introduction to Philo Judaeus*, New Haven, 1940; Harnack, (2), 1909, 125; I. H. Heinemann, *Philons griechische und jüdische Bildung*, Breslau, 1932; E. Herriot, *Philon le Juif*, 1898; Hölscher, PW, ix, 1959; Inge, ERE, i, 308; ix, 308; Lauterbach, JE, x, 6; Leisegang, PW, xiii, 1078; xxxix, 1–50; C. Siegfried, *Philo von Alexandria*, Jena, 1875; Soltau, 87; Stählin, in Christ, 1920, II, i, 478–506; Thorndike, (1), i, 348; Ueberweg, (1), i, 566; Wendland, JE, i, 368; H. A. Wolfson, *Philo. Foundations of Religious Philosophy in Judaism, Christianity, and Islam*, 2 vols., Cambridge, Mass., 1947 (review by L. Roberts, *Isis*, 1949, xl, 199); Zeller, (1), III, ii^4, 385.

[2] Drummond, i, 12.

[3] Greek text: ed. T. Mangey, 2 vols., f°, London, 1742 (with Latin tr.); A. E. Pfeiffer, 5 vols., Erlangen, 1785–92; L. Cohn and P. Wendland, 6 vols., Berlin, 1896–1915, and index by Leisegang, 1926; tr. (mostly from Mangey) by C. D. Yonge, *The Works of Philo Judaeus*, 4 vols., 1854–5 (ref. in footnotes as *Works*); L. Cohn, *Werke*, 5 vols., Breslau, 1909–19; text and tr., Loeb ed., 9 vols., 1929 f.

[4] Edersheim, DCB, iv, 373; E. Meyer, (2), ii, 366.

[5] *De somniis*, i, 22; *Works*, ii, 321.

[6] *Works*, i, 78; iv, 289.

[7] *Gen.*, xv, 10; Wolfson, i, 314; Harnack, (2), 1909, 129, called this 'spiritual alchemy.'

[8] Reitzenstein, (5), 107; Wolfson, i, 102 f.

the regular solids, and water and earth are feminine or passive and air active. The air is full of souls. The ether is a fifth element, identified with the Stoic divine fire (ἱερὸν πῦρ) or with unquenchable flame (φλὸξ ἄσβεστος).[1] Philo attributed colours to the elements: earth white, water purple (the sea forming the purple fish), air hyacinth or black, fire red.[2] The signs of the zodiac produce colours in air, water, and earth, and act in changes of these elements, and on plants, animals, and men.[3] Every element is inhabited, animals on land, fish in the sea, stars in the ether, and hence invisible spirits (not birds) must be in the air.[4] He attached great importance to the number seven, which began in heaven with the planets and he gives many examples of things occurring or related in sevens.[5] The seven vowels α ε η ι υ ο ω denote the seven planets.[6] Philo disapproved of scientific astronomy as a useless study of the Chaldaeans, but he was more favourable to astrology.[7] He took over the Stoic theory of sympathy from Poseidonios.[8]

The universe, which is one organic whole with parts connected by eternal law, will never perish.[9] The stars (as with Plato) are divine beings.[10] The moon is not pure ether, like other stars, but contains some air, which accounts for its spots.[11] Man is a microcosm standing between the mortal and immortal, the noblest creature.[12] God is impersonal, remote, with no attributes (ἄποιος), being as such (τό ὄν), alone real in the true sense, and light (φῶς). His two aspects are the good (ἀγαθότης) or formative (ποιητική), corresponding with θεός, and might (ἐξουσία) or ruling (βασιλική), corresponding with κύριος, in the *Septuagint*.[13]

Philo's famous theory of the Logos (λογός) is obscure and vacillating. God acts through his Logos, which is sometimes the divine creative word, sometimes an immaterial emanation, sometimes his image as the intellectual world (κόσμος νοητὸς) existing before the creation in God's thought, sometimes ether, sometimes pneuma, sometimes the primary man conceived as God's image as distinguished from the material Adam, sometimes an interpreter (ἑρμηνεύς) or instrument (ὄργανον) of God. For the Stoics, the Logos was God, for Philo it is second to God.[14]

Acting on passive matter were the Stoic seminal reasons (λόγοι σπερματικοί), identified with Plato's ideas (ἰδέαι), which Philo called powers or immaterial

[1] Arnold, 23; Baeumker, 383; Drummond, i, 270–310 (ether doubtful); Edersheim DCB, iv, 377, 380; Heinze, 226; Inge, (1), i, 149; Philo, *Works*, ii, 33, 119, 134, iv, 409, 454; Wolfson, i, 300, 309, 323; Zeller, (1), III, ii[4], 435–42.
[2] *Works*, ii, 181; Josephus, *Wars*, VI, i, 5.
[3] *Works*, iii, 99 f., 195; Reitzenstein, (5), 168 f.
[4] *De somniis*, i, 21–2; *Works*, ii, 321.
[5] *De mundi opificio*, 30–42; *Works*, i, 36, 54 f.
[6] Fahz, *A. Rel.*, xv, 420; Zeller, (1), III, ii[4], 439.
[7] Drummond, i, 264 f., 282 f.
[8] Zeller, (1), III, ii[4], 439.
[9] Drummond, i, 288 f., 314 f.; ii, 69.
[10] Barth, 264.
[11] *De somniis*, i, 22.
[12] Drummond, i, 69, 288 f., 314 f.; Edersheim, DCB, iv, 381; Wolfson, i, 425.
[13] Deussen, (1), II, i, 475 f.; Drummond, ii, 85; Zeller, (1), III, ii[4], 377, 403 f., 415 f.
[14] Arnold, 23; Barth, 286 f.; Billings, 26, 37; Deussen, (1), II, i, 476; Dodd, (1), 120; Drummond, ii, 116; Edersheim, DCB, iv, 384; Heinze, 215, 220 f., 252 f., 278; Leisegang, PW, xiii, 1078; E. Meyer, (2), ii, 366; Ueberweg, (1), i, 569; Wolfson, i, 200 f.; Zeller, (1), III, ii[4], 408. 423, 430.

forces (ἀσωμάτοις δυνάμεσιν) or emanations, (ἀπόρροια).[1] Man was created by the assistance of demiurges.[2] Philo's doctrine of six 'powers' nearest to God has been compared with the Iranian six Amesa Spenta surrounding the throne of Ahura Mazda.[3] Philo took over the Stoic seven divisions of the soul (the five senses, speech, and generation), distinguished ἕξις, φύσις, and νοῦς ('the soul of the soul', which came from God and was equivalent to spirit or pneuma). He tended to spiritualise pneuma, which became θεοῦ πνεῦμα, yet he admitted a cohesive pneuma (πνεῦμα ἑκτικὸν) corresponding with Stoic ἕξις (see p. 159).[4] Philo's ideal man (ἄνθρωπος θεοῦ) was pre-existent; he did not descend into matter but a new earthly man was created in his pattern.[5] Philo was more studied by Gentiles than Jews, who soon discarded his works.[6] His originality is defended by Wolfson.[7]

APION

Apion ('Απίων), the grammarian and sophist of Alexandria, fl. *c.* A.D. 38, attacked the Jews in a lost work on Egypt, and was answered by Josephus (πρὸς 'Απίωνα). He was head of the Alexandrian School and is described as very boastful; the emperor Tiberius called him *cymbalum mundi*. Seneca[8] said his enquiries dealt with things which, if known, should be forgotten, and if unknown should not be learnt. Pliny, who saw Apion in his younger days (perhaps when he visited Rome with a deputation from Alexandria opposing that led by Philo Judaeus in A.D. 39/40) says Apion raised the spirit of Homer to ascertain his birthplace and parentage but did not disclose the answer; he used the magic plant *osiritis* and said there was in existence in Egypt a statue of Serapis made from a single emerald nine cubits high.[9] Aelian[10] says he investigated the habits of the scarabæus and measured the length of the intestines of the ibis. The story of Androcles and the lion is given by Aulus Gellius[11] on the authority of Apion. Only fragments of his writings survive.[12] A book by Apion on mineral or metallic medicines (*de metallica medicina*) is mentioned by Pliny.[13] Wellmann thought Apion (like Simon Magus) used Neopythagorean sources; he was called[14] a pupil of Simon and a magician.

PSEUDO-CLEMENT

Two works attributed to Clement, bishop of Rome (Clemens Romanus fl. *c.* A.D. 95) are of later date. One, *Homilies*[15], exists in Greek; the other,

[1] Bigg, 12; Deussen, (1), II, i, 470; Drummond, ii, 147; Inge, (1), 1929, i, 98; Zeller, III, ii[4], 406 f., 416, 429 f.
[2] Edersheim, DCB, iv, 381.
[3] Billings, 45; Charles, (1), ii, 534; Gray, *A. Rel.*, vii, 359.
[4] Billings, 47 f.; Edersheim, DCB, iv, 381; Verbeke, 237, 240–2, 250, 255 f.
[5] Wesendonk, (1), 94 f.
[6] Glover, 160.
[7] i, 88 (he had some knowledge of Hebrew), 98 f., 176 f.; ii, 114 f., 414, 439 f.
[8] *Epist.* 88.
[9] Pliny, xxx, 6; xxxvii, 19.
[10] *H. Animal.*, x, 29.
[11] *Noctes Atticae*, V, xiv, 1.
[12] FHG, iii, 506–16; Bayle, i, 262; Cohn, PW, i, 2803; Hausrath, (2), i, 206; Kohler, JE, i, 666; Lightfoot, DCB, i, 128; Mommsen, v, 517; Schmitz, DBM, i, 226; Wellmann, (5), 62.
[13] xxx, Elenchus.
[14] ψ-Clement, *Homil.*, iv, 6; v, 3, 5.
[15] Ed. A. R. M. Dressel, Göttingen, 1853; Migne, PG, 1857, ii, 57; ed. P. de Lagarde, Leipzig, 1865; tr. T. Smith, J. Peterson, and J. Donaldson, ANL, 1870, xvii.

Recognitions (*Recognitiones*, perhaps originally 'Ἀναγνώσεις) exists only in a Latin translation by Rufinus (d. A.D. 410)[1] and some Syriac fragments.[2]

The *Homilies* and *Recognitions* were dated about A.D. 150,[3] but are now thought to be not earlier than 200–280, probably about 300. They were composed in Syria, by putting together a *Kerygma of Peter* (*c.* A.D. 200) and an anti-gnostic Jewish-Christian work, by a small and obscure sect, perhaps under Iranian influence.[4] The physics is commonplace Stoic, probably from Poseidonios;[5] Isidore of Seville (7 cent.) often quotes the works. God created the four οὐσίαι, hot, cold, dry, and moist, and the primary matter (πρώτη ὕλη) and formed it according to the four opposites, converting air into water, water into earth, and earth into fire (by the collision of stones). From the four elements by combination (μῖξις) an infinite number of mixtures (κράσεις) are formed, all related, since the universe is one great animal.[6] According to Orpheus, all the elements formed a chaos like an egg, but (as the peacock's egg contains potentially all the coloured feathers of the bird, capable of development) under the influence of the divine spirit (πνεῦμα θεῖον) the egg of chaos brought forth an androgyne (ἀρρενόθηλυ) god Phanes (see p. 5), who rose upwards, whilst the remaining matter sank into the depths, and was called Pluto, the king of the dead.[7] The information about Simon Magus is given later (see p. 254).

[1] Ed. E. G. Gersdorf, Leipzig, 1838; Migne, PG, 1857, i, ii; tr. M. Dods and T. Smith, ANL, iii.

[2] *Recognitiones Syriace*, ed. P. A. de Lagarde, Leipzig, 1861; ed. W. Frankenberg, TU, 1937, xlviii, no. 3.

[3] J. Langen, *Die Clemens-Romane*, Gotha, 1890, 68; Soltau, 245.

[4] Bousset, *A. Rel.*, xviii, 153, 160, 162; Duschesne, i, 95; Harnack, (2), i, 332; W. Heintze, Der Clemensroman und seine griechischen Quellen, TU, 3 ser., 1914, x, no. 2 (date, 110 f., 113); M. R. James, (1), xxiv; Jülicher, PW, iv, 16; D. G. Krüger, (1), 235; Nau, DTC, iii, 201; Salmon, DCB, i, 554, 567; C. Schmidt, TU, 1929, xlvi, no. 1; G. Uhlhorn, RPTK, iv, 171; H. Waitz, TU, 1904, x, no. 4.

[5] Heintze, 94 f. [6] *Homil.*, ed. Dressel, 95. [7] *Ib.*, 95, 157–60.

CHAPTER IX

MEDICINE AND TECHNOLOGY

The Pneumatic School

The teachings and terminology of the Stoics were absorbed into an important medical school which, since it laid great stress on the activities of pneuma (πνεῦμα) or spirit, was called the Pneumatic School. It also taught that fire, air, water, and earth are not real 'elements', these being the qualities (ποίοτης) which they possess; heat and cold are efficient causes, and dryness and humidity material causes.[1]

The Pneumatic School assumed as basic elements the four qualities, with pneuma (πνεῦμα) as a fifth, determining all bodily functions.[2] The fundamental ideas go back to Erasistratos of Ioulis in the island of Keos (fl. *c.* 258 B.C.).[3] He paid particular attention to the circulation of pneuma, and (as a pupil of Straton) the horror of a vacuum (*πρὸς τὸ κενουμενον ἀκολουθία*). The vacuum is discontinuous, innumerable minute empty spaces interposed with the atoms of a body. The spaces in the human body are filled with pneuma. He also used Peripatetic and Stoic principles.[4]

The body is composed of atoms and the sources of organic energy are blood and pneuma, which is renewed by respiration, air penetrating to the left side of the heart through the pulmonary vein and forming vital pneuma (πνεῦμα ζωτικόν) and soul pneuma (πνεῦμα ψυχικόν), the first propelled by the arteries and regulating the vegetative processes in the body and the second reaching the brain, combining with the vital spirits, and causing muscular movement and sensation by passing through the hollow motor and sensory nerves. The arteries are filled with air (pneuma), a view held by his teacher Praxagoras of Kos (fl. 330–300 B.C.), who recognised eleven humours as causes of disease.[5]

According to Erasistratos, in generation the active pneumatic power (δύναμις) of the sperm moves the matter (ὕλη) of the passive menstrual

[1] Deussen, (1), II, i, 415; Diels, (2), 41 f., 43; Gilbert, 225 f., 251, 392; Haeser, (1), i, 229 f., 234, 238 f., 249 f.; R. James, 1743, i, Pref., xxxv f.; Meyer-Steineg and Sudhoff, 123 f.; Sprengel, (1), i, 375; ii, 69; Wellmann, (2); *id.* in Susemihl, ii, 414 f.

[2] Neuburger, i, 226; Jaeger, *Hermes*, 1913, xlviii, 29; E. Neustadt, *ib.*, 1909, xliv, 60; Wellmann, PW, ii, 2034.

[3] Friedländer, i, 341; Greenhill, DBM, ii, 42; Schubart, (2), 115; Tarn, (1), 271.

[4] Allbutt, 224; Brock, (1), 14; Deussen, (1), II, i, 415; Diels, (2), 41; *id.*, *Sitzb. Berlin Akad., phil.-hist. Kl.*, 1893, 101; J. F. Dobson, *Proc. Roy. Soc. Med.*, 1927, xx, 825; Fuchs, in Puschmann, (1), i, 373; Gilbert, 225, 251, 389, 392; Greenhill, DBM, ii, 42; Haeser, (1), i, 238; J. Kroll, (1), 260, 279; Meyer-Steineg, 75 f., 80; M. Neuburger, (1), i, 177; Sprengel, (1), i, 442; Verbeke, 175 f., 188, 191; Wellmann, PW, vi, 338–50.

[5] Edelstein, OCD, 727.

blood to produce the fœtus.[1] He postulated four organic forces: nourishing in the liver, heating in the heart, perceiving in the nerves, and thinking in the brain. He denied the importance of innate heat; in digestion food is divided by trituration in the stomach, mixes there with pneuma from the arteries, and is carried to the liver, where it changes into blood. He attached little importance to the Hippokratic humours. His rival, Herophilos of Chalcedon, mainly an anatomist, disregarded them; he assumed that the arteries contain blood, not air, and are connected by minute capillaries with the veins, but these function only in disease.[2]

Archigenes of Apamea, who was in Rome in Trajan's time (A.D. 98–117), distinguished three kinds of pneuma: ἑκτικόν or cohesion, φυσικόν or vital force, and ψυχικόν distributed throughout the body and the source of life and intellect. Animal heat is produced by motion of pneuma, and is tempered by respiration, in which some pneuma is absorbed from the air. There are eight bad temperaments (δυσκρασίαι).[3]

The Empiric School

The Empiric School rejected atomism and Hippokratic theory, relying upon observation and experiment (τήρησις), clinical cases, and if necessary analogy (ἡ τοῦ ὁμοίου μετάβασις). Disease is a concurrence (συνδρομος, syndrome) of symptoms, for each of which a specific drug was used: 'cures are by medicines and not arguments.' Many popular remedies were used. The school claimed philosophic descent from the Sceptic Pyrrhon of Elis (*c.* 350–270 B.C.), a follower of Demokritos.[4] It was founded by Philinos of Kos (fl. *c.* 250 B.C.)[5] or by Serapion of Alexandria (fl. *c.* 220 B.C.).[6] Pliny[7] says the Empirics were so named from their experiments (ab experimentis), of which Galen said they had three kinds: chance, impromptu, and imitative (observation of many instances under the same conditions).[8]

Herakleides of Tarentum (fl. 75 B.C.) dissected and wrote on drugs (litharge, alum, vitriol, verdigris, white lead, copper scales, galls, earth wax, turpentine, crocus, and opium), and poisons and antidotes.[9] He was criticised by Apollonios of Kition (in Alexandria about 50 B.C.),[10] who, and Glaukias of Tarentum (or Thettalos) (fl. *c.* 75 B.C.),[11] wrote commentaries on Hippokrates. Aelios Promotos of Alexandria (*c.* A.D. 140–90), an Empiric, wrote a Δυναμερόν (*Medicinalium Formularum Collectio*), a work on poisons, etc.[12]

1 Festugière, (2), III, lxxxix, xciii f. Galen attributed this theory to Athenaios.
2 Gossen, PW, viii, 1104; Greenhill, DBM, ii, 438; Haeser, (1), i, 234.
3 Verbeke, 191 f., 199; Wellmann, PW, ii, 484.
4 Brock, (1), 15; Haeser, (1), i, 245; Meyer-Steineg, 90; M. Neuburger, (1), i, 189.
5 Diller, PW, xix, 2193.
6 Brock, (1), 17; Gossen, PW, II Reihe, ii, 1667; Greenhill, DBM, iii, 736; Meyer-Steineg, 91; Sarton, *Isis*, 1930, xiv, 463.
7 xxix, proem., 4.
8 Galen, ed. Kühn, i, 135, 144; xvi, 82; Thorndike, (1), i, 156.
9 Gossen, PW, viii, 493; Susemihl, ii, 420.
10 Wellmann, PW, ii, 149.
11 Cichorius, *Rhein. Mus.*, 1908, lxii, 223; Gossen, PW, vii, 1399.
12 Greenhill, DBM, i, 29; Haeser, (1), i, 248; Wellmann, PW, i, 528.

Asklepiades of Prusa

Asklepiades of Prusa in Bithynia (*c.* A.D. 124–40), usually grouped with the Empiric School, studied in Alexandria and practised in Rome, where he achieved great eminence. He prescribed medicines, including wine, and criticised the Hippokratic method of letting 'Nature' cure as 'a careful study of death'. He rejected the humours and is said to have first divided diseases into acute and chronic.[1] His teachings are known only from fragments.[2] Asklepiades adopted an atomic theory, either from Epikouros or (as Sextos Empirikos says) from Herakleides of Pontos (*c.* 360 B.C.), who is mentioned by Diogenes Laertios,[3] as writing 'against Demokritos', perhaps because Herakleides admitted *variable* corpuscles (ὄγκοι).[4] Asklepiades postulated 'particles (ὄγκοι, *onkoi*)', and ducts or pores '(πόροι, *poroi*)', into which they entered. Disease is due to 'stagnation (ἔνστασις, συνίστασις, *statis*)' of the particles. The idea of aggregation by movement of atoms into suitable pores had been put forward by Epikouros.[5] Asklepiades described the particles as discrete or not touching (ἄναρμοι), small (λεπτομερεῖς), and having a peculiar motion tending to subtilise the parts of matter (πρὸς τὸ λεπτομερες φορά). They are divided by collisions with one another into smaller and smaller particles of different sizes and shapes without limit, and so differ from indivisible atoms.[6] The *onkoi* have been identified with molecules,[7] but since they are not said to be composed of a small and definite number of atoms, and are said to be infinitely divisible, recent criticism[8] agrees that they are not the same as the modern molecules. Origen[9] speaks of 'atoms', as either incapable of subdivision or as subdivided into *equal* parts, which may (if it does not refer to the *minimæ partes* of Epikouros (see p. 141)) suggest a division of an ὄγκος into atoms.

Asklepiades connected the sizes of the *onkoi* with those of the channels or pores (πόροι) through which they pass, and supposed that the heat of fever is due to the vibration of particles obstructed in the pores, which are themselves collections of atoms.[10]

[1] Allbutt, 179; Baeumker, 325; Brock, (1), 17; H. Bruns, *Quæstiones Asclepiadæ de vinorum diversis generibus*, Parchim, 1884; Diels, (2), 16, 42; J. S. Elliott, 23, 53; Fuchs, in Puschmann, (1), i, 323; Greenhill, DBM, i, 381; Haeser, (1), i, 262; *id.*, (2), 48; R. James, i, Intr.; D. Le Clerc; Lessing, 75; Neuburger, (1), i, 201; A. G. M. Raynaud, *De Asclepiade Bithyno Medico ac Philosopho*, Thesis, Paris, 1862; Schelenz, 161; Sprengel, (1), ii, 3; Streeter, *Isis*, 1922, iv, 355; Susemihl, ii, 431; H. von Vilas, *Der Arzt Asklepiades von Bithynien*, Vienna and Leipzig, 1903 (esp. 17, 29, 37 f.); Wellmann, PW, iv, 1632; *id.*, *N. Jahrb. klass. Altertum*, 1908, xxi, 683–703 (thinks Asklepiades was anticipated in this application of atomism by an obscure Aigimios of Elis); *id.*, (3); Zeller, (1), III, i[4], 569.

[2] Galen, ed. Kühn, xiv, 223; xx, 71–2; Pliny, xxvi, 7, 8; *Asclepiadis Bithyni Fragmenta. Digessit et cvravit C. G. Gumpert. . . . Praefatvs est D.C.G. Grvner*, Vinariae, 1794 (Vilas, 5, says this is very rare).

[3] v, 86–93; Loeb ed., 1925, i, 538.

[4] Sprengel, (1), ii, 6.

[5] *Ep.* i, 47, 61: πάντα πόρον σύμμετρον.

[6] Caelius Aurelianus, *Morb. Acut.*, I, xiv, 105 f.; (1), 66 f.; Galen, ed. Kühn, i, 490; ii, 31; xiv, 250.

[7] Brock, (1), 153; Gumpert, 40, 57, 136; Lasswitz, (1), i, 213, 229; Vilas, 37 f.; Wellmann, *N. Jahrb. klass. Alt.*, 1908, xxi, 695.

[8] C. Bailey, (1), 286, 342, 577; LSJ, 118; Ueberweg, (1), i, 445 ('discrete particles'); Zeller, (1), III, i[4], 571.

[9] *De Princip.*, IV, i, 33; ANL, x, 349.

[10] M. Neuburger, (1), i, 203; Sprengel, (1), ii, 14.

Caelius Aurelianus[1] says Asklepiades taught that food breaks down into *leptomeres* in the stomach and these pass into the vessels as 'what we understand by spirits (nos intelligimus spiritum)'. He gave the only detailed account now available of the corpuscular theory of Asklepiades, which thus became familiar to medical men.[2]

THE METHODIC SCHOOL

This school, which lasted into the Middle Ages, was supposed (Edelstein says wrongly) to have been founded by Themison of Laodicea (fl. *c.* 50 B.C.), a pupil of Asklepiades of Prusa, who opposed the humoral theory of Hippokrates but also rejected atomism, considering only the pores in Asklepiades' system. Disease is caused by their relaxation (ῥυσίς, *laxum*) or constriction (στεγνωσις, *strictum*). Later, a 'mixed state (τὸ μεμιγμένον)' was added, making three 'forms (κοινότητες, *communitates*)' of disease, which was due to a 'community' in the body.[3] The real founder of the school may have been Thessalos of Tralles (d. in Rome before A.D. 79), who modified the *communia* to refer to the visible morbid change, which must be changed into the opposite. Every disease was an entity.[4] This greatly simplified medical theory and Galen[5] said Themison secured many pupils by promising to teach medicine in six months, so that tailors, dyers, and smiths turned to it. The most important Methodic physician was Soranos of Ephesos (fl. in Rome *c.* A.D. 98–138), whose book on acute and chronic diseases is the basis of that of Caelius Aurelianus (see p. 191).[6] The school was very influential and was known in the Middle Ages in the Latin translations of the work of Moschion (of North Africa, 6 cent.).[7]

ANONYMUS LONDINENSIS

In 1891 a Greek papyrus brought from Egypt to the British Museum, and dated *c.* A.D. 150, was examined by Kenyon[8] and Diels.[9] The author is unknown and the work is called *Anonymus Londinensis*.[10] It comprises three, perhaps unconnected, parts: (1) definitions, (2) quotations from various named authorities (some otherwise unknown) on the causes of diseases, (3) the development of physiology after 300 B.C. It was perhaps copied from lecture-notes of students, the latest authority quoted being Alexander

[1] *Morb. Acut.*, I, xiv, 113, 115; (1), 71–3.
[2] Lasswitz, (1), i, 214.
[3] Allbutt, 192; Brock, (1), 18; Edelstein, PW, 1935, Suppl. vi, 358–73; Haeser, (1), i, 268; Meyer-Steineg, 104.
[4] Diller, PW, 1936, II Reihe, vi, 168; Edelstein, OCD, 900.
[5] Kühn, x, 4–5, 10.
[6] Greenhill, DBM, iii, 378; fragms. in Ideler, (1), i, 248–60; first in Greek in works of Rufus of Ephesos, 8°, Goupyl, Paris, 1554 (Lippmann, *Isis*, 1928, xi, 161, correcting Sarton, (1), i, 283, 433).
[7] Sarton, (1), i, 433.
[8] *Class. Rev.*, 1892, vi, 237; Allbutt, (1), 127.
[9] *Hermes*, 1893, xxviii, 407.
[10] Greek text ed. Diels, Anonymi Londinensis ex Aristotelis Iatricis Menoniis et aliis medicis Eclogae, in *Supplementum Aristotelicum*, Berlin, 1893, III, i; text and tr. by W. H. S. Jones, *The Medical Writings of Anonymus Londinensis*, Cambridge, 1947; German tr. by H. Beckh and F. Spät, *Anonymus Londinensis. Auszug eines Unbekannten aus Aristoteles-Menons Handbuch der Medizin und aus Werken anderer älterer Aerzte, Deutsche Ausgabe*, Berlin, 1896 (BM 07306. g. 10); see Leicester, *Chymia*, 1961, vii, 9 (28) (an early text-book of biochemistry); M. Neuburger, (1), i, 111, 186; Wellmann, (1), 5, 52, 70, 75, 79, 82.

Philalethes (end of I cent. B.C.),[1] and Diels thought it was compiled from his (unknown) writings.

The second part often quotes 'Aristotle' and since Galen[2] says a summary of medicine (ἰατρικὴ συναγωγή) attributed to Aristotle was written by his pupil Menon (who thus lived in the 4 cent. B.C.),[3] Diels thought it gives his teaching. Wellmann[4] thought it was by Soranos of Ephesos (fl. A.D. 98–138). Asklepiades of Prusa, who is called the 'wine-giver (οἰνοδότης)', is mentioned several times, and the work in its present form contains Stoic doctrines.

The author says[5] man is composed of body and soul, but 'I leave the discussion of the soul to others'. An account of the medical views of Plato is taken from the *Timaios*,[6] although the distinction between blending (σύνφθαρσις), mixtion (μῖξις), and compounding (διάκρασις)[7] is Stoic. There are two main theories of the cause of disease: (1) the residues (περίσσωμα) of nutriments, (2) disturbance of the elements (στοιχεῖα), attributed to Hippokrates.[8] Herodikos of Selymbria (mentioned by Plato) said food taken without previous exercise is not digested and its residues form an acid and a bitter liquid which, carried in the blood to the heart and other organs, causes diseases.[9] Thrasymachos of Sardis (otherwise unknown) believed that excess of cold or heat converted blood into phlegm, or bile, or pus, producing diseases.[10] Philistion (4 cent. B.C.) thought that health results when the whole body breathes well and the breath (πνεῦμα) passes unhindered.[11]

Since we can taste food, some is absorbed in the mouth, but most of it in the stomach, where digestion is 'a change and fine grinding as an aid to seething'. Digestion continues in the intestines, nutriment being absorbed through pores or vessels growing into them, and is absorbed by veins, if not also by arteries. The residues are excreted and eaten by animals and birds, which in turn are eaten by man, so that 'the residues of men become once more their nutriment'.[12] The 'inferior and more sluggish parts' of the nutriment are excreted as fæces, the pungent and salty parts are attracted by the bladder and excreted in urine.[13]

Emanation (ἀποφορά) is given off by everything, which in consequence loses weight; warm (fresh) loaves are heavier than cooler, fresh meat is heavier and more nourishing than 'high' meat.[14] The Empiric School (see p. 184), it is said, opposed these arguments, saying that a decrease in weight of a body does not necessarily imply a loss of substance, but may be due to the addition of air or spirit (πνεῦμα), which would make a body lighter:[15]

If anything suffers a decrease, it does not necessarily become lighter, nor if it suffers an increase need it become heavier; for sometimes a decrease makes a thing heavier, as in the cases of skin-bags, dead animals, and flowers. First they consider the skin-bag: if the bag is empty of air it is heavier, but when filled with air it is lighter. Animals are composed of body and soul (ψυχή) . . . when the soul leaves the body, this becomes heavier.

[1] Greenhill, DBM, i, 125. [2] Kühn, xv, 26.
[3] Raeder, PW, xv, 927; Zeller, (1), II, ii[3], 897.
[4] *Hermes*, 1905, xl, 580; 1922, lvii, 397; 1926, lxi, 329; Jones, 7–8, thinks doubtful.
[5] Jones, 83. [6] *Ib.*, 3, 59 f. [7] *Ib.*, 60–1. [8] *Ib.*, 11, 32, 38, 80. [9] *Ib.*, 15, 32.
[10] *Ib.*, 52–4. [11] *Ib.*, 80. [12] *Ib.*, 98–102. [13] *Ib.*, 114–16. [14] *Ib.*, 118.
[15] Diels, text, 58 f. (xxxi–xxxii, ll. 25 f.); Beckh and Spät, xix, 47; Jones, 119–23; Partington and McKie, *Ann. Sci.*, 1938, iii, 1.

Most scientists (συνέστηκεν) say that the soul (ψυχή) is corporeal (σώματος). The soul in an animal is light because it is air (πνεῦμα) and air is light by nature. The whole body, in fact, is moved by the earthy and airy and by the soul which carries these elements, and holds it up. A thing becomes heavier not when anything enters it but when something heavy is added. The soul is not by nature heavy, but tends upwards and makes lighter, and when it is present the body is light. But when the soul escapes the levitating and weight-opposing part is no longer there, and clearly the dead body is heavy by its loss. Also with air (πνεύματος)-filled bags, lightness is found because air is light and makes the bag light. If the air is not in it, the bag becomes heavy, because it is deprived of the levitating cause.'

Water when boiled or heated becomes less; the warmth, which naturally rises, bears away moisture in the form of steam, and similarly warmth carries away emanation from our bodies, evaporation occurring continually. Heavy and thick particles are thrown off with difficulty, light and active particles easily, as would happen if motion is the cause of emanation, which goes on continuously. Breath, cold when inhaled, is warm when exhaled and has certain additions made to it, although part is expended in the body, and exhaled breath is greater than inhaled.[1] Erasistratos said that if a bird 'or something of the sort' is put in a pot for some time, and was then weighed along with its visible excrement, there will be a great loss in weight, because a copious emanation has taken place.[2] Material can enter as well as leave through pores.[3] Demokritos, after fasting four days, when he nearly died, was taken into a bakery, where he revived by inhaling the steam from the loaves.[4]

In the work *dynamis* (δύναμις) has a meaning different from Aristotle's 'potentiality' (see p. 81), and rather in the sense of an essential property or quality.[5] The word πνεῦμα is used sometimes in a sense which Jones[6] translates 'gas' circulating in the body, although this is sometimes called 'wind (φῦσα)'. The theory of the 'abhorrence of a vacuum (ἀθροῦς κενὸς),' was taken from Erasistratos, and the 'affections (πάθη)' are classed as abnormal conditions of the body or the soul.[7]

Medicine in Rome

Greek medicine was introduced into Rome by Archagathos about 219 B.C.[8] He invented a plaster containing *misy* (impure green vitriol), burnt copper, white lead, litharge, and turpentine resin. Physicians were not esteemed and were mostly foreigners; there was animosity among them and quacks abounded. Popular medicine, using household recipes like those described by Pliny,[9] flourished along with scientific medicine using expensive prescriptions made up by apothecaries.[10]

Aurelius Cornelius Celsus (*c.* B.C. 30 or 25–A.D. 45 or 50) lived in Rome.[11]

[1] Jones, 84–90.
[2] *Ib.*, 126: centuries before Sanctorius, see Vol. II, p. 442
[3] *Ib.*, 142.
[4] *Ib.*, 138, q. Asklepides of Prusa; the story is in Diogenes Laertios, ix, 43.
[5] *Ib.*, 9, 24, 80, etc.
[6] *Ib.*, 10, etc.
[7] *Ib.*, 12.
[8] Celsus, *De medicina*, V, xix, 27; Pliny, xxix, 6; Wellmann, PW, ii, 432.
[9] Bks. 20–32.
[10] Dill, (1), 92, 105, 132 f.; Friedländer, i, 301 f., 339 f., 351; M. Neuburger, (1), i, 282 f.; A. Schmidt, 7, 10; Streeter, *Isis*, 1912, iv, 355.
[11] Allbutt, 202; Bloch, in Puschmann, (1), i, 415; Greenhill, DBM, i, 660; Haeser, (1), i, 276; Ilberg, *N. Jahrb. klass. Altertum*, 1907, xix, 377; W. H. S. Jones, in Singer, (4), i, 103; E. H. F. Meyer, ii, 4; Wellmann, PW, iv, 1273.

There has been discussion as to whether he was a layman[1] or a practising physician.[2] His *De Medicina* in 8 books[3] may be based on a Greek work by Menekrates, physician to Tiberius or Claudius,[4] and be part of an encyclopædia called *De Artis*. The pharmacology is better than in later works. It mentions (without name) diabetes.[5]

Scribonius Largus (*c.* A.D. 1–50), in Rome in the time of Tiberius, accompanied Claudius on his British campaign in A.D. 43, after which he wrote his *Compositiones* (prescriptions),[6] which mentions 242 vegetable, 36 mineral, and 27 animal drugs, with some magic remedies. The earliest accurate description of the preparation of opium is given, and the application of the electric ray (*silurus* fish)[7] for severe headache is the first medical use of electricity. Galen's account of opium, a century later, is not nearly so good.[8] Menekrates of Zeophleta (1 cent. A.D.) invented diachylon (διὰ χυλῶν) plaster (litharge, oil, marrow, and herb juices).[9]

Andromachos of Crete, physician to Nero (A.D. 54–63), is said to have added viper's flesh to the *theriac* (from θηριακή, venomous beast) or universal antidote to poisons reputed to have been invented by Mithridates, king of Pontos (*c.* 120–65 B.C.), containing 54 or 61 ingredients,[10] including squills, opium, pepper and dried vipers. In the 18 cent. it was made in Venice and called 'triacle' or 'treacle', later in Naples; in the Middle Ages it was a remedy for the plague.[11]

Xenokrates of Aphrodisia (*c.* A.D. 70) wrote works on *Drugs* and *Animal Food*[12] full of superstitious and occult remedies, used by Pliny (bks. 28–30) and quoted by Byzantine authors.[13] Galen[14] charged him with using disgusting remedies prepared from parts of the human body, including blood and brain, but Pliny,[15] who gives scores of remedies from the human body and animals, calls Ostanes 'the inventor of these monstrosities'.

[1] Ebstein, OCD, 177; Meyer-Steineg and Sudhoff, 106.

[2] Greenhill; W. G. Spencer, *Proc. Roy. Soc. Med., Hist. Med.*, 1926, xix, 129; *Isis*, 1928, x, 110; H. R. Viets, *ib.*, 110.

[3] Ed. C. Daremberg, Leipzig (Teubner), 1891; F. Marx, in CML, Leipzig, 1915, i; W. G. Spencer, 3 vols., Loeb, 1934–38–55 (list of drugs, II, xv–lv; instruments, lx–lxiii; weights and measures, lxv–lxvi; symbols, lxvi–lxvii).

[4] Wellmann, (3), 64; *A. Med.*, 1924, xvi, 209; *Isis*, 1928, xi, 159; Garrison, *Ann. Med. Hist.*, 1926, viii, 203; Ebstein says several Greek sources; it was lost till 1426.

[5] *De Med.*, IV, xx, 2: urina super potionum modum . . . profluens.

[6] Ed. Helmreich, Leipzig (Teubner), 1887; Eitrem, i, 104; Greenhill, DBM, ii, 722; Kind, PW, II Reihe, ii, 876; E. H. F. Meyer, ii, 26; W. Schonack, *Die Rezeptsammlung des Scribonius Largus*, Jena, 1912 (BM); Sprengel, (1), ii, 54.

[7] See Aristotle Pliny, v, 10; vi, 37; ix, 17.

[8] Israelson, 101.

[9] Greenhill, DBM, ii, 1036.

[10] Pliny, xxv, 2; xxix, 8; Galen, ed. Kühn, xiv, 32 (recipe in verse); Lenz, (2), 197; E. H. F. Meyer, ii, 41; A. Schmidt, 10–12 (in full); Sprengel, (1), ii, 56; Thorndike, *Isis*, 1927, ix, 29, 35.

[11] Adams, (1), iii, 528 (excluded from London *Pharmacopœia* in 1750 by 14 votes to 13); C. E. Daniels, *Janus*, 1911, xvi, 371, 457; J. Nohl, *The Black Death*, tr. C. H. Clarke, 1926, 74, 90, 104.

[12] Ideler, (1), i, 121.

[13] Heinze, *Xenokrates*, Leipzig, 1892; J. Kroll, (1), 83; E. H. F. Meyer, ii, 55; Tamborino, De antiquorum dæmonibus, RVV, 1909, VII, iii; Wellmann, *Hermes*, 1907, xlii, 614 (thinks the catalogue of gems in Pliny, bk. 37, is from a dictionary of gems. *Λιθογνώμιον*, by Xenokrates, an Egyptian).

[14] Kühn, xii, 248 f.

[15] xxviii, 2.

Dioskourides

Dioskourides (Διοσκουρίδης, the prefix Pedanios or Pedakios has no authority; commonly called Dioscorides) born in Anazarba near Tarsos, Cilicia, was a physician in the Roman army under Tiberius and Nero and probably wrote about A.D. 60. He is not mentioned by, and does not mention, Pliny, and the two probably wrote independently. Since they often agree, they may have used the same sources, including the *Materia Medica* (περὶ ὕλης ἰατρικῆς) of Sextius Niger (under Augustus, 63 B.C.–A.D. 14).[1] Besides medical authors Dioskourides quotes Demokritos, Ostanes, Pythagoras, and Zoroaster.[2] His *Materia Medica* (τὰ τῶν ὑλικῶν βιβλία or περὶ ὕλης 'ιατρικῆς) in five books contains descriptions of all the materials then used in medicine and their supposed virtues. About 600 plants are described. An illustrated MS. (*Codex Aniciæ Iulianæ*), *c.* A.D. 512 (mentioned by Cassiodorus, *c.* A.D. 540) from Constantinople and now in Vienna, has been published (2 vols., Leyden, 1906). Two different Latin versions were made in the 6 cent., Arabic translations in Baghdād about A.D. 854 and Cordova about A.D. 951,[3] and a Syriac translation about 1250.[4] Many editions in Greek (first, Venice, 1499) and Latin (first, Colle, 1478) were printed.[5] All quotations are from the edition of Saracenus. Three other works attributed to Dioskourides are: (1) *On Simple Medicines* (περὶ ἁπλῶν φαρμάκων, or Εὐπόριστα),[6] perhaps 3–4 cent., (2) *On Poisons* (περὶ δηλητηρίων φαρμάκων, and (3) *On Venoms* (περὶ ἰοβολων), perhaps 7–8 cent.[7] Another Dioskourides (Phakās) of Alexandria, *c.* 41–30 B.C., is mentioned by Galen.

Dioskourides, Pliny, and Galen are supposed to have used an illustrated herbal (ῥιζοτομικόν) and a work on mineral and aromatic drugs (περὶ μεταλλικῶν φαρμάκων καὶ ἀρωμάτων), now lost, of Krateuas, physician to King Mithridates Eupator (132/120–

[1] Arnim, PW, II Reihe, ii, 2040; Wellmann, *Hermes*, 1889, xxiv, 530–69.

[2] Allbutt, 373; Budge, (3), 63; Diels, *Abhl. Akad. Berlin, phil.-hist. Kl.*, 1906, 29; Fabricius, (1) (*a*); 1708, iii, 88; 1719, ix, 436; 1795, iv, 673 (MSS and eds.); Fuchs, in Puschmann, (1), i, 349; Greenhill, DBM, i, 1051; Haeser, (1), i, 302; Lippmann, (1), i, 47; *Isis*, 1928, xi, 160; E. H. F. Meyer, ii, 96, 116; Meyer-Steineg, 126; Singer, (5), ii, 63; *J. Hellenic Stud.*, 1927, xlvii, 1 (19); *Isis*, 1928, x, 520; Sprengel, (1), ii, 58 f.; Thorndike, (1), i, 605; Wellmann, PW, v, 1131. For botanical glossaries, see Delatte, (1), 273–454.

[3] Leclerc, *J. Asiatique*, 1867, ix, 5–38.

[4] Meyerhof, QS, 1933, iii, 280.

[5] Fabricius, (1) (*b*), 1795, iv, 692 f.; Giedemeister and Hoffmann, i, 21; ed. Janus Antonius Saracenus, f°, Frankfurt, 1598; Kühn, *Medicorum Græcorum Opera*, Leipzig, 1829–30, xxv–vi; Wellmann, *Pedanii Dioskurides Anazarbi De Materia Medica libri quinque*, 3 vols., Berlin, 1907–14 (order of text altered, some doubtful readings); Latin trs., J. Ruelle, f°, Paris, 1516, 1543; Matthiolus (see Vol. II, p. 83), *Pedacii Dioscoridis Anazarbi de Materia Medica libri sex. Ope Matthioli*, Lyons (Balthazar Arnolletus), 1554, 8° (16°) (xvi ll., 564 pp. text, lxxiv ll. (unpaged) notes) (BM 433. a. 10) (D.D.J., *Nature*, 1922, cix, 807); German tr. J. Berendes, *Des Pedanios Dioskurides aus Anazarbos. Arzneimittellehre . . . übersetzt und mit Erklärungen versehen*, Stuttgart, 1902; old English tr., R. T. Gunther, *The Greek Herbal of Dioscorides*, Oxford, 1934; also French, Italian, and Spanish. Commentaries by Hermolao Barbaro, *In Dioscoridem Corollariorū libri quinque*, f°, Cologne, 1530 (BM 449. i, 4, with Greek and Latin text by Marcellus Vergilius, f°, Cologne, 1529), Matthiolus (see Vol. II, p. 83), etc.

[6] Edelstein, OCD, 290 (spurious); Wellmann, PW, ii, 1131 (spurious); *id.*, *Hermes*, 1898, xxxiii, 360 (authentic).

[7] Allbutt, 379; Greenhill, DBM, i, 1052.

65/63 B.C.)[1] A *Herbarius* attributed to Apuleius was compiled about A.D. 400 almost entirely from Pliny.[2]

MINOR PHYSICIANS

Soranos of Ephesos, who studied in Alexandria and practised in Rome under Trajan and Hadrian (A.D. 98–138), restored the Methodic school (p. 186) by moderating its exaggerations; he was widely read in the Middle Ages.[3] Soranos was the main source for Cælius Aurelianus of Sicca, Numidia (*c.* A.D. 400), whose treatises on swift or acute diseases (*Celerum vel Acutum Passionum*) and chronic diseases (*Tardarum Passionum*) are probably translations of two works of Soranos.[4]

Aretaios of Cappadocia (*c.* A.D. 120–200) followed the lead of Archigenes. He was much admired by Boerhaave, who published his works (Leyden, 1735). He distinguished the vital force (ζωτικὴ δύναμις) from the soul and vital heat.[5] Aretaios first used the name diabetes (διαβήτης),[6] but perhaps for polyuria rather than diabetes mellitus. Rufus (Ῥοῦφος) of Ephesos (*c.* A.D. 150) worked in Rome and Egypt, and was used by Galen.[7]

Quintus Serenus Sammonicus, murdered by order of the emperor Caracalla in A.D. 212, was a literary man who left his large library to a son of the same name. His medical poem called *De Medicina Præcepta Saluberrima*, contains extracts from many authors. It may have been written by the son and in its present form may be relatively late.[8] It contains the famous 'abracadabra' charm, to be written on papyrus with repetitions in lines below one another, leaving out successive letters on the right until only A was left at the corner of the triangle. Such triangles occur in Greek magic papyri[9] and were used as charms against plague in the 16–17 cents., together with mercury and arsenic enclosed in hazel nuts.[10] Many suggestions as to the origin of *abracadabra* have been made including one from the gnostic *abraxas* (p. 262), but the most likely is from the Aramaic *abbada kedabra*, 'perish [the disease] like the word.'[11]

[1] Hoefer, NBG, 1855, xii, 373; Meyer-Steineg, 219; Singer, *J. Hellenic Stud.*, 1927, xlvii, 1 Sarton, (1), i, 213, 259; *Isis*, 1929, xi, 272; Wellmann, *Abhl. K. Ges. Wiss. Göttingen, phil.-hist. Kl.*, 1897, ii, 1.

[2] Ed. Ackermann, *Parabilium Medicamentorum Scriptores*, Nürnberg and Altdorf, 1788, 127–294, and notes; ed. F. W. T. Hunger, Leyden, 1935; Neuburger, (1), i, 308; Schwabe, PW, ii, 246.

[3] Ed. Ilberg, in CMG, 1927, iv; Haeser, (1), i, 304; Kind, PW, II Reihe, iii, 1113; Meyer-Steineg, 115; M. Neuburger, (1), i, 234; Sprengel, (1), ii, 33.

[4] Ed. and tr. by I. E. Drabkin, Chicago, 1950, with intr. and notes; Greenhill, DBM, i, 438; Haeser, (1), i, 321; E. H. F. Meyer, ii, 226; M. Neuburger, (1), i, 309; Sprengel, (1), ii, 37; Wellmann, PW, iii, 1256.

[5] Ed. C. Hude, CMG, 1923, ii; Kühn, *Medicorum Græcorum Opera*, 1828, xxiv; ed. and tr. F. Adams, 1856; Haeser, (1), i, 341; M. Neuburger, (1), i, 230; Wellmann, PW, ii, 669.

[6] *De Morb. Diut.*, ii, 2; Lippmann, (1), i, 326; *Isis*, 1928, xi, 161; Papaspyros, *History of Diabetes Mellitus*, 1952.

[7] Text and tr. Daremberg and Rouelle, Paris, 1879; Gossen, PW, II Reihe, i, 1207; Haeser, (1), i, 336; Schmid, in Christ, II, ii, 740.

[8] Ed P. Burman, *Poetæ Latini Minores*, 4°, Leyden, 1731, ii, 185–388, with notes; F. Nollmer, CML, 1916, II, iii; P. Pépin, Paris, 1950, with tr. and notes; Bloch, in Puschmann, (1), i, 506, 622; Hoefer, (1), i, 236; E. H. F. Meyer, ii, 209; M. Neuburger, (1), i, 299; Nollmer, *Philologus*, 1919, lxxv, 128; Ramsay, DBM, iii, 786; Sprengel, (1), ii, 175; Sudhoff, MGM, 1916, xv, 441.

[9] Eitrem, i, 8, 13, 95; PGM.

[10] J. Nohl, *The Black Death*, 1926, 98.

[11] E. Bischoff, 95; Budge, (4), 220; Hubert, DS, III, ii, 1505; Jacoby, HDA, i, 95, 99; Migne, (1), i, 17.

Philoumenos (fl. A.D. 180 or 250) in a work on animal poisons (περὶ ἰοβόλων) and antidotes[1] describes the preparation of *ptisana* (barley gruel) and calves' feet jelly by heating with water in a closed vessel, a kind of Papin's digester:[2] mitti in ollam novam cum aqua pluriale vespere et clausam ollam illiniri et in furno mitti carbonibus pleno ardentibus. The water bath is mentioned in the Hippokratic works (see p. 33), and the oil bath by Galen.[3]

GALEN

Galen (Γαληνός; the name 'Claudius' has no authority) (Pergamos, A.D. 129–in Sicily ?, 199) was carefully educated in mathematics and philosophy, began to study medicine at the age of 17, and travelled extensively to complete his education, visiting Smyrna, Cyprus, Corinth, Greece, Asia Minor, Palestine, and Alexandria; in 163–4 he went to Rome, where he became court physician to Marcus Aurelius. He wrote extensively on philosophy as well as on medicine, and composed a great number of works, some say 500. He quotes his authorities and in many cases is now the only source for these. His treatment is usually critical but too polemical. He was the first to study experimental physiology in the modern sense.[4] The works were first printed in Latin (Venice, 1490), the first Greek text (from a single MS.) in Venice, 1525.[5] The printed works consist of 83 treatises regarded as genuine, 19 questionable, 45 spurious, 19 fragments, and 15 commentaries on Hippokrates. There were many Hebrew and Arabic translations.[6] Galen combined the

[1] Text and tr., Puschmann, *Nachträge zu Alexander Trallianus*, in *Berliner Studien für classische Philologie*, 1886, v, no. 2; ed. Wellmann, in CMG, 1908, i; *id.*, *Hermes*, 1908, xliii, 373–404; Greenhill, DBM, iii, 334.

[2] Puschmann, 42, 46; Lippmann, (1), ii, 201.

[3] *De sanit. tuenda*, iv, 8; Kühn, vi, 290.

[4] Ackermann, in Fabricius, (1) (*b*), 1796, v, 377–500; *id.*, in Kühn, i; Allbutt, 347; J. H. Baas, *Outlines of the History of Medicine*, tr. Henderson, New York, 1889, 168; Brock, (1), 21; *id.*, (2), pref. (G. b. A.D. 131); Daremberg, (2), 59; Dill, (1), 92, 102; Fabricius, (1) (*a*), 1708, iii, 509; Friedlander, i, 354, 365, 515; Fuchs, in Puschmann, (1), i, 373; Greenhill, DBM, ii, 208; Haeser, (1), i, 347; J. Ilberg, *Rhein. Mus.*, 1889, xliv, 207; 1892, xlvii, 489; 1896, li, 165, 466; 1897, lii, 591; *N. Jahrb. klass. Alt.*, 1905, xv, 276; *A. Med.*, 1930, xxiii, 289; *Isis*, 1930, xv, 397; 1933, xix, 381 (G. b. A.D. 129); R. James, I, pref. lxiii; Laśswitz, (1), i, 230; Leicester, *Chymia*, 1961, vii, 9 (32); R. Maillard, *Aperçu historique sur Galien et ses ouvrages*, Thesis, 1865 (BM 7383. ddd. 1. (1.)); A. Malloch, *Ann. Med. Hist.*, 1926, viii, 61 (G. b. A.D. 131); L. Meunier, *Janus*, 1904, ix, 270, 313; Mewaldt, PW, vii, 578; E. H. F. Meyer, ii, 187; Meyer-Steineg, 131, 201; *id.*, *A. Med.*, 1911, v, 172; 1913, vi, 417; M. Neuburger, (1), i, 242, 271, 350; Sarton, (1), i, 301-7; *id.*, *Galen of Pergamon*, Lawrence, Kansas, 1954; Schmid, in Christ, 1913, II, ii, 732; C. Singer, (1), 123; *id.*, (2), 50; *id.*, *Galen on Anatomical Procedures*, 1956; Sprengel, (1), ii, 96–125; Sudhoff, *A. Med.*, 1925, xvii, 140; H. O. Taylor, *Greek Biology and Medicine*, 1922; Thorndike, (1), i, 117–81; Ueberweg, (1), i, 562; Verbeke, 206–19; Walsh, *Ann. Med. Hist.*, 1927, ix, 132; 1929, i, 378; 1932, iv, 126; 1934, vi, 1, 143; 1935, vii, 428, 570; 1936, viii, 65; 1937, ix, 34; 1939, i, 525 (b. 22 September, A.D. 130); Zeller, (1), III, i³, 823.

[5] Ackermann, in Kühn, I, xvii–cclxv; Schmid, in Christ, 1913, II, ii, 743.

[6] L. Leclerc, i, 242–52; Meyerhof, *Isis*, 1926, viii, 685–724; M. Neuburger, (1), i, 249, 359; list of lost works, and of authors quoted by Galen, in Fabricius, (1) (*a*), iii, 552–90. *Opera*, Greek and Latin, ed. René Chartier and (after his death in 1654) F. Blondel and A. Lemoine, 13 vols. f°, Paris, 1679; ed. K. G. Kühn, 20 vols. 8°, Leipzig, 1821–33 (based on Chartier's and giving the pagination of this; omits many spurious treatises in Chartier's ed. and all the notes and alternative readings), q. in refs. here as K; *Scripta Minora*, Leipzig (Teubner), 1884, i (ed. Marquardt); 1891, ii (ed. Müller); 1893, iii (ed. Helmreich); 1904, iv (ed. Helmreich); *De usu partium*, ed. Helmreich, 2 vols., 1907–9; *Logica*, 1896 (ed. Kalbfleisch); *De victu attenuate*, 1908 (ed. Kalbfleisch). Various works by various editors in CMG (1914, V9, 1; 1915, V9, 2; 1923, V4, 2; 1934, V10, 1; 1936, V10, 2.1; 1937, V4, 1.1); *De Hippocratis et Platonis*

Hippokratic theory of the four humours (p. 29), the Aristotelian of the four elements (p. 85),[1] and the Stoic pneuma theory (p. 158), and attempted to incorporate Alexandrian anatomical and physiological discoveries into medicine. He opposed atomism and materialism. His views on various authorities, on the necessity for experiment (or experience) and reason, and his preference for Dioskourides in place of Pamphilos,[2] are sound. He compounded drugs from a knowledge of the disease and the properties of simple drugs.[3] He[4] used *experimentum* for medical treatment, recipe, or prescription. His attitude to magic is sceptical for his time,[5] although he prescribed some disgusting remedies.[6] He says no one has ever claimed to have seen a basilisk.[7] A man claimed to kill a scorpion by spitting on it and repeating an incantation, but Galen found that the incantation was unnecessary, since human saliva is fatal to scorpions.[8]

He believed in ligatures, charms, astrology and divination by dreams, and to a limited extent in the medical virtues of gems, but condemned the baser forms of magic.[9] Superstitious medicine, based on the occult qualities of animals, plants, gems, etc., was prevalent in his time.[10] It was sharply satirised by Loukian (A.D. 120–200),[11] but was encouraged by the Stoic doctrine of sympathy (*συμπάθεια τῶν ὅλων*), particularly emphasised by Poseidonios (see p. 162), and had an apparent experimental foundation in the attraction of iron by the magnet, its classical example, which much impressed Galen.[12] He says the fact that a string of five iron rings can be hung from a magnet disproves the explanation of magnetic attraction given by Epikouros that it is due to atoms flowing from both the magnet and iron fitting one another so closely that the two are drawn together.[13] The shock of the torpedo fish (*νάρκη*), which is transmitted through a metal trident, is compared with the action of the magnet.[14]

Pharmacology

Galen's pharmacology is mostly contained in four works:

1. *περὶ κράσεως καὶ δυνάμεως τῶν ἁπλῶν φαρμάκων* (*De temperamentis et facultatibus simplicium medicamentorum*) in 11 books (bk. iii on the temperaments of drugs): K, xi–xii.[15]

placitis, ed. (with Latin tr.) I. Müller, Leipzig, 1874 (Vol. i, all publ., but contains all 9 books); *De Facultatibus naturalibus*, ed. and tr., A. J. Brock, Loeb, 1916 (text of Helmreich, *Script. Min.*, 1893, iii). Selected works tr. C. Daremberg, (3).

[1] K, i, 509 f.

[2] K, xi, 794–5; xiii, 658; xiv, 61–2.

[3] K, xii, 895; xiii, 463, 700; xiv, 222.

[4] K, xi, 205.

[5] Thorndike, (1), i, 165 f.

[6] K, xii, 293; vols. xi–xii contain some spurious works.

[7] K, xii, 250; xiv, 233.

[8] K, ii, 163; xii, 288.

[9] K, iv, 688; ix, 901; xii, 207, 251 f., 263, 283; xiv, 321, 601, 625, 655; xix, 529 (some spurious works).

[10] Allbutt, 347 f.; Dill, (1), 132 f.; Eitrem, 31, 51, 90, 99, 103, 105, 107, 124, 127, 131, etc.; Friedländer, i, 365 f; Hausrath, (1), i, 131 f.; Lenz, (1), 27 f.; M. Neuburger, (1), i, 285; Riess, PW, i, 29; A. Schmidt, 12 f.; Sprengel, (1), ii, 151; Thorndike, (1), i, 44; Wellmann, *Hermes*, 1907, xlii, 614.

[11] *Philopseudes or the Liar*; (1), iii, 230 f.

[12] M. Neuburger, (1), i, 286, 288, 290; Stemplinger, *A. Med.*, 1920, xii, 33.

[13] K, ii, 45–8; Diels, *Sitzb. Akad. Berlin, phil.-hist. Kl.*, 1893, 113 (from Straton through Erasistratos ?).

[14] K, viii, 422.

[15] Israelson, tr. of books 6–10 from Kühn, xi, with notes, incl. refs. to Abū Manṣūr Muwaffak. The material is mostly from Dioskourides.

2. περὶ συνθέσεως φαρμάκων τῶν κατὰ τόπους (*De compositione medicamentorum secundum locus*): K, xii–xiii.

3. περὶ συνθέσεως φαρμάκων τῶν κατὰ γένη (*De compositione medicamentorum secundum genere*): K, xiii.

4. περὶ ἀντιδότων (*De antidotis*): xiv, 1–209.

5. Two works on the *theriac* are regarded as spurious: (*a*) περὶ τῆς θηριακῆς πρὸς Πίσωνα (*De theriaca ad Pisonem*). (*b*) περὶ τῆς θηριακῆς πρὸς Παμφιλιάνον (*De theriaca ad Pamphilianum*): K, xiv, 210–310.

A treatise on weights and measures (K, xix, 748–81), a subject to which he paid great attention (K, xiii, 435, 893; Israelson, 20), is spurious.

Galen preferred medicines tested by his own experience, but gives some from 'the most experienced' and some recent writers.[1] His pharmacology is very extensive and complicated and he is said to have derived a large income from the sale of drugs,[2] mostly known before him and not very effective. His compound medicines often contain 25 or more ingredients. He regarded mercury as a poison, unfitted for internal use[3] but prescribed opium,[4] which had been introduced in Alexandria and was frequently adulterated.[5] He defines drugs (φαρμάκα) as substances which, as contrasted with foods, give rise to certain changes in the organism, and he divided them into three classes: (i) drugs which exert their action through the elementary qualities, hot, cold, dry, and moist; (ii) drugs which act through the secondary qualities of attracting, fixing, transforming, expelling, and excreting, viz. sour, bitter, sharp, acid, astringent, and relaxing remedies; (iii) drugs which act, in a manner which cannot be explained, by virtue of the substance as a whole and the tertiary qualities, as emetics, purgatives, antidotes, etc., which exert a specific action on certain organs by their entire nature and not through the elements of which they are composed, their action depending on the temperament (see p. 196) of the patient.[6] Antidotes were ἀλεξιφάρμακα, those operating against animal poisons being ἀλεξητέρια, but the first name was also used in a general sense for a drug used internally.[7] Galen distinguished four degrees of action: (1) slight, (2) distinct, (3) drastic, and (4) destructive. Poisons are hot or cold in the fourth degree. The medical treatment is based on the *contraria contrariis*, i.e. an allopathic system. An elementary quality, e.g. heat, may be manifest *in actu* (in fire) or *in potentia* (in pepper). A drug or material in equilibrium (εὔκραστον) or 'symmetry' with the body exerts no action and is indifferent.[8]

Each degree had three subdivisions, beginning, middle, or end. The narcotics opium, mandragora, and hemlock were cold in the fourth degree, hemlock being at the end. Rose is cool in the second degree but by mixing it with oil (indifferent or of zero degree) its cold could be diluted to the first degree, and by mixing a very cold drug with a slightly cold drug in various proportions a compound drug of any desired degree of coldness can be

[1] K, xii, 392–3, 884, 968, 988; xiii, 116–17, 123, 125, 128–9, 485, 502–3, 582, 656; his expression 'long experience' is a favourite one, e.g. K, xii, 988; xiii, 960–1, etc. He laid stress on the purity of drugs: K; xi, 488, etc.

[2] Haeser, (1), i, 374.

[3] K, xi, 767; xii, 237.

[4] K, xiii, 155, 272 f.; xviiA, 904; etc.

[5] Sprengel, (1), i, 456.

[6] K, i, 469; xii, 357; E. G. Browne, (1), 119 f.; Meyer-Steineg, 135; M. Neuburger, (1), i, 271; Sprengel, (1), ii, 122.

[7] Israelson, 15.

[8] K, xi, 518 f.; M. Neuburger, (1), i, 271.

obtained.[1] Solids like stones and metals are dry and cold, and their dryness is incurable. Hot and moist things tend to evaporate quickly into the air, or else are resolved into sensible fumes (εἰς τὸ περιέχον ἀει σκίδναται τάχισται, ποτὲ μὲν εἰς αἰσθητοὺς ἀτμοὺς λυομένη, ποτὲ δ' εἰς ἀδήλους μὲν τῇ ὄψει).[2]

Roman apothecaries' shops were called *seplasia* and the drugs in them were mostly adulterated.[3] Dealers in drugs were *pigmentarii*, *seplasii*, *pharmacopolae* (φαρμακοπώλης), and *medicamentarii*; a store of any kind was an *apotheca* and its proprietor an *apothecarius*; the limitation to drugs came much later and even in the 13–14 cents. an *apothecarius* might be a confectioner.[4] Galen[5] mentions stocks of drugs in the imperial stores (ἐν ταῖς αὐτοκρατορικαῖς ἀποθήκαις), which, also those in the shops (which closed at night), came packed in labelled cartons from agents in Crete, Sicily, and Africa.[6] Some drugs, e.g. cinnamon, spoiled on keeping.[7] To obtain genuine drugs a physician made long voyages or relied on trustworthy friends.[8]

Galen visited Lemnos to obtain *terra sigillata*, and took from Thessalonika 20,000 stamped discs of the earth, which he was told was not then mixed with goat's blood[9] (as Dioskourides[10] had asserted). Galen describes the *sory*, *misy* and *chalkitis* mines in Cyprus, and the manufacture of *pompholyx* and *spodos* in the brass furnaces there.[11] He refers to drugs of Great Syria, Palestine, Egypt, Cappadocia, Pontus, Macedonia, Gaul, Spain, Mauretania, Keltic lands, and India. Much so-called Attic honey really came from the Cyclades and was reshipped at Athens, and imitations of Falernian wine were made. The best unguent was formerly made only at Laodicea but a similar one was then made in various places in Asia Minor.[12] Dealers in wild beasts used medicinally (for theriac) practised many frauds.[13] One could spend a lifetime reading books on simple medicines, some by people who had never seen the plants they described. He condemned Egyptian sorceries, uses of incantations, amulets and magical devices, which are utterly false.[14] Galen describes poisons but not in detail, for the sake of safety.[15]

Physical and Medical Theories

All natural objects are composed of four elements, fire, air, water, and earth[16] (a theory which he says Hippokrates first introduced and Aristotle later demonstrated), and are characterised by four qualities, hot, cold, moist, and dry, from the combination of which various secondary qualities are produced.[17] He argued against only one element,[18] and says some regarded hot and cold as words for bath attendants, not physicians.[19] Philosophers do not think any particular sort of earth or mineral is the pure element earth, which is an extremely cold and dry substance approximated to by diamond and rocks; all the earths we see are compound bodies.[20] He rejected the atomic

[1] K, xiii, 948; Israelson, 14–15.
[2] K, x, 657.
[3] Pliny, xxxiv, 25.
[4] Beckmann, (1), i, 326 f.; Marinden, DA, ii, 382; Thorndike, i, 129.
[5] K, xiv, 26.
[6] K, xiv, 10, 26, 30, 79.
[7] K, xiv, 64–6.
[8] Friedländer, i, 354.
[9] K, xii, 168–78.
[10] v, 113.
[11] K, xii, 226–9.
[12] K, xii, 215–16; xiii, 119, 411–12; xiv, 7–9, 22–3, 77–80.
[13] K, xiv, 255–6.
[14] K, xi, 792 f.; xiii, 658, 1041; xiv, 9, 61–2.
[15] Friedländer, i, 359 f.
[16] K, x, 16–17.
[17] K, xiii, 763–4.
[18] K, i, 428.
[19] K, x, 109–11.
[20] K, xii, 166.

theory, saying that the grouping of atoms will not explain why a compound differs from those of its constituents, or the alteration of qualities in artificial mixtures.[1] Galen differed from Aristotle and followed the Stoics (p. 155) in regarding air as cold.[2] In his work *On the Uses of the Parts of Man* he says that every organ is placed where it can best carry out the work prescribed for it by Nature.

Drugs also have 'natures' and each 'draws' that humour which is proper to it (ἐπάγεσθαι τὸν οἰκεῖον ἑαυτῷ χυμόν),[3] as the magnet attracts particles of iron. The retentive force or epispastic faculty (ἐπισπαστική δύναμις) attracts its proper humour.[4] This theory of attraction and nutrition was rejected by Erasistratos, who had a theory of abhorrence of a vacuum (τὸ κενούμενον ἀκολουθίας), which Galen ridicules at length.[5]

Galen recognised four 'temperaments (κράσεως)' or 'complexions', (1) bilious (hot and dry), (2) melancholic or atrabilious (μέλαν χολή, black bile) (cold and dry), (3) phlegmatic (cold and moist), and (4) sanguine (hot and moist).[6]

Mizāj (temperament) is still a common word in Arabic, Persian, and Turkish for 'health', derived from a root meaning 'to mix' (κρᾶσις), it indicates a state of equilibrium of the four natural properties or four humours. Al-Majusi (d. A.D. 982) called the four humours the 'daughters of the elements'. Every large Arabic work on medicine opens with chapters on the temperaments, the natural properties (heat, cold, dryness, and moisture) and the four humours.[7]

Physiology

Galen recognised three kinds of 'powers' or 'faculties', corresponding with the three divisions of the soul, viz. (1) spiritual, (2) natural, and (3) vital.[8] Any operation of a living part may be conceived in three ways as: (1) a δύναμις (faculty, potentiality), (2) an ἐνέργεια, which is this δύναμις in operation, and (3) an ἔργον, the product or effect of the ἐνέργεια. He postulated four activities: (1) attraction of likes, (2) repulsion or rejection, (3) retentive force (καθεκτική δύναμις), and (4) transformation (ἀλλοιωσις).[9] This theory he attributes to Hippokrates.[10]

The 'nature' of the organism (ἡ φύσις ἥπερ διοικεῖ τὸ ζῷον), the study of which was 'physiology (φυσιολογία)', operates by an artistic creativeness (τέχνη) in producing growth and nutrition, which are dependent on the activities (faculties, or powers) by virtue of which each part draws to itself what is proper or appropriate to it (το οἰκεῖον) and rejects what is foreign (τὸ αλλότριον); thereafter it appropriates or assimilates the attracted material by an alteration or qualitative change (ἀλλοίωσις), an example of active motion (δραστικὴ κίνησις), following the process of specific selection (ὁλκὴ τοῦ οἰκείου); 'the stronger draws and the weaker is evacuated (ἕλκει μὲν οὖν τὸ ἰσχυρότερον, ἐκκενοῦνται δὲ τὸ ἀσθενέστερον).'[11] Every part has a

[1] K, xiv, 250–3.
[2] K, ix, 510; Lasswitz, (1), i, 233 (Galen was later quoted as an authority for this view).
[3] K, ii, 44, 47–8, 54. [4] K, ii, 144. [5] K, ii, 63–6. [6] K, i, 518; ii, 136–40.
[7] E. G. Browne, 119 f., 125.
[8] K, ii, 1 f.; Brock, (2), xxix; Daremberg, (2), 81; Israelson, 16.
[9] K, ii, 143–5; Israelson, 14; Reinhardt, (2), 55 f. (from Poseidonios).
[10] K, ii, 38, 57. [11] K, ii, 44, 47–8, 54, 57, 85 f., 143–4, 188 f.; Brock, (2), xxvi–xxix.

'craving (ὄρεξις)' to be nourished and 'wraps itself around the nutriment (περιπτύσσεται τῇ τροφῇ)' as the stomach does.[1] Coction (πέψις) is compared with fermentation.[2]

Digestion and Nutrition

Digestion is a species of alteration (ἀλλοίωσις), a transmutation of nutriment (μεταβολή τοῦ τρέφοντος) into the proper quality of the thing receiving it, and, with the nature of the surplus substances (περιττώμασι), is the result of the natural or innate heat (ἐμφύτον θερμός).[3] Galen knew that saliva takes part in digestion, since if some corn is chewed and then put in a paste of raw wheat, this is rapidly digested. Digestion proceeds further in the stomach, around which the other viscera are set like fireplaces round a great cooking-pot, and it is completed in the intestines, for nothing is altered at once from one quality to another. Digestion, as the ancients said, is a kind of cooking (ἡ πέψις ἑψήσει παραπλήσιος ὑπάρχειν).[4]

The nutritive faculty is the cause of nutrition (θρέψις), which is an alteration (ἀλλοίωσις) different from genesis (γενέσις).[5] Things are assimilated because they possess a certain community and affinity in their qualities (κοινωνίαν ἤδη καὶ συγγένειαν ἐν ταῖς ποιότησι).[6] Many organs are concerned, since the changes do not happen at once, white not becoming black by a single change (as yellow becomes red) but by passing through stages. For blood to become flesh is easy, but to form bone it must become thickened and white; and bread, and more so lettuce, beet, and the like require a great deal of alteration to become blood. The superfluities (περιττωμάτων) are also different from different foods, meat having hardly any and radishes much, and these are collected in reservoirs before they are discharged.[7] The blood undergoes varying degrees of coction, so varying in thickness, heat, etc., and each kind nourishes the organ most like it. The four humours are formed from various kinds of blood.[8]

> 'Nature acts throughout in an artistic and equitable manner, having certain faculties by virtue of which every part of the body draws to itself the juice which is proper to it (ἐφ' ἑαυτὸ τὸν οἰκεῖον ἑαυτῷ χυμόν), and having done so attaches it to every portion of itself and completely assimilates it, while such part of the juice as has not been mastered (μὴ κρατηθὲν) and is not capable of undergoing complete alteration (ἀλλοίωσίν) and being assimilated to the part which is being nourished, is got rid of by yet another faculty', an 'expulsive' faculty to explain excretion.[9]

Foods of warmer nature produce bile, those of colder nature produce phlegm and these produce hot and cold diseases, the primary diseases being four in number.[10] Galen distinguished between what is virtually (δύναμιν) and apparently (φαντασίαν) warm, dry, etc.; yellow bile is warm and virtually dry although it is apparently moist, and blood is moist and virtually warm.[11]

In the formation of blood, the nutriment (τροφή, i.e. digested food) is resolved into its thick and earthy part, which does not take on the alteration

[1] K, ii, 199. [2] Brock, (1), 186. [3] K, ii, 25, 89–90, 113, 136, 162 f.
[4] K, ii, 163–7, 188; Meyer-Steineg, 133; *A. Med.*, 1911, v, 172; 1913, vi, 417; Meyerhof, *Isis*, 1935, xxiii, 100.
[5] K, ii, 11, 19. [6] K, ii, 20, 133. [7] K, ii, 21–3.
[8] K, iv, 754. [9] K, ii, 30. [10] K, ii, 118. [11] K, ii, 129–30.

produced by innate heat, and is drawn away by the spleen; and the warm, moist, thin, sweet and roasted (θερμότατον) part is cleared away as yellow bile by the biliary vessels. If the yellow bile has been excessively roasted it becomes yellow, acrid, and viscous like yolk of egg and is abnormal; so is black bile which has been burnt, as it were, into ashes (τέφρα). Nature has made no organ for removing phlegm, which runs down from the brain as mucus (βλέννα).[1]

Pathology

Disease is contrary to nature and caused by some defect in the right proportion of the elements, one or two of which predominate. It is cured by something contrary to the disease itself (*contraria contrariis*). It is useless to treat the symptoms, since these will disappear automatically if the cause of the disease is removed. For fevers Galen gave cold water.[2] He attributed fevers to putridity of the humours (σῆψις χυμῶν) in stagnation and exposed to a high temperature without evaporation (μὴ διαπνεῖσθαι πᾶσαν τὴν ἀτμίδα); deposits in urine are a sign of this.[3] He attributed more importance to anomalies of the blood than to those of other humours, thus preparing the way to haemo-pathology, and transformed the pneumatic theory into the theory of fever and inflammation.[4]

Galen discussed a large number of medical terms in a very polemical treatise *On Medical Names*. The Greek text is lost, but a Syriac translation of the first three of its five books was made by Ḥunain ibn Isḥāq (A.D. 809–877), and the first was translated into Arabic by his nephew Ḥubaish. This Arabic translation exists in a 13-cent. MS. at Leyden.[5]

Pneuma

Galen divided the constituents of the body into three groups: (1) the solid ***parts*** (μόρια), subdivided into (*a*) similar (ὁμοιομηρῆ), giving similar parts on division, such as bone and flesh, and (*b*) dissimilar (ἀνομοιομηρῆ) or organic, such as arms, legs, etc.; (2) four liquid ***humours*** (χυμοί), blood, phlegm, bile, and black bile; and (3) three ***spirits*** or pneumas (πνεύματα), still essentially material, (*a*) natural (πνεῦμα φυσικὸν), a subtle vapour arising from the blood and presiding over nutrition, growth, and generation, (*b*) vital (πνεῦμα ζωτικὸν) located in the heart and distributing warmth and life through the arteries, and (*c*) animal or psychic (πνεῦμα ψυχικὸν) in the brain, distributed through the (hollow) nerves and giving motion and sensation to the parts. There are three corresponding ***actions*** (δύναμις ψυχικὸν etc.) and an internal and external form of each. The source or principle of the motion of all faculties is nature (φύσις).[6]

The psychic pneuma is not the substance of the soul (ψυχή) but its primary

[1] K, ii, 136–40.
[2] K, ii, 127–8; Brock, (1), 183; J. S. Elliott, 106; M. Neuburger, (1), i, 271; Sprengel, (1), ii, 118.
[3] K, vii, 290, 301, 374, 396, 401; x, 599 f.; Sprengel, (1), ii, 119.
[4] M. Neuburger, (1), i, 261.
[5] L. Leclerc, i, 154–7; Meyerhof, *Isis*, 1926, viii, 685 (708); *Forschungen und Fortschritte*, 1929, v, 398.
[6] *De placit. Hippocr. et Plat.*, viii; K, v, 608; ed. Müller, Leipzig, 1874, 604; Daremberg, (2), 81; Meyer-Steineg, 132; Sprengel, (1), ii, 117. He thus adopted Plato's theory of three souls in man rather than Aristotle's of one soul located in the heart.

instrument, a view derived from Erasistratos.[1] The vital pneuma is composed of inspired air and exhalation from the blood (τῶν χυμῶν ἀναθυμιάσεως), but the air must undergo a kind of digestion (κατεργασθέντος) in which, as in the digestion of food, part is assimilated and part rejected, this process occurring mainly in the lungs; respiration also serves to temper the vital heat:[2]

> 'The substance of the lung appears rare and full of air, so showing that it was prepared to elaborate air, as that of the liver to elaborate foods. For it is natural that the exterior air does not serve immediately and all at once to replenish the pneuma contained in the animal body, but is transformed little by little, as foods are. It thereby acquires the quality appropriate to the interior air, and the primary organ of this change is the substance of the lung, as that of the liver is the principle of the transformation of foods into blood.'

Life depends on the constant renewal of pneuma, absorbed from the air by respiration (ἀναπνοή), which occurs through the lungs, the pores of the skin, and the arteries.[3] He had an idea of the smaller, but not the general, circulation of the blood in the body. He rejected Plato's doctrine of a world soul.[4] Some thought the soul caused the parts to grow, others that one soul constructs them and another incites them to voluntary motion.[5] Galen proved experimentally that the arteries contain blood, not pneuma, but still thought the pulmonary vein conveys spirit, not blood, to the heart.[6]

Respiration

It is important to breathe plenty of fresh and invigorating air, unpolluted by exhalations from mines, pits, furnaces, putridity from decaying vegetable and animal matter, or noxious vapours from stagnant water, swamps, and rivers. Plague is due to a poisonous corruption in the air.[7] In his book on the use of respiration (περὶ χρείας 'Αναπνοῆς (*De Usu Respirationis*))[8] Galen considers whether respiration serves for the generation of the soul (ψῦχή, animae generatio) as Asklepiades taught, or for strengthening the soul (animae corroboratio) according to Praxagoras, or for cooling the innate heat (innati caloris refrigeratio) according to Philistion and Diokles, or for nutrition and cooling according to Hippokrates, or, finally, for replenishing the arteries (arteriarum expletionis), as Erisistratos taught. He says[9] that a flame perishes without air, and respiration conserves the animal heat (ζώοις θερμασία). As a smoky flame is brightened by more air, inspiration of pure air increases animal heat, and expiration carries off the smokiness (αἰθαλῶδες ἐκπνεύσασαν), or ventilates the fumous (λιγνύς) in the blood. Flames are produced and maintained by the right amount of air, blown out by too much air, and extinguished by lack of air, as can be seen in cupping glasses (ἰατρῶν σικύαι, medicinales cucurbitae). The nutriment of the flame rises, as can be seen with a torch or candle just blown out, and the air moves from above to meet this. The air in

[1] Wellmann, (2), 134, 163, 204, 215.
[2] *Du usu partium*, vii, 8; K, iii, 539–40; ed. Helmreich, 1907, i, 392. 17–24; Daremberg, (1), i, 475; Verbeke, 207, 215, 219–20; see Vol. II, p. 524.
[3] M. Neuburger, (1), i, 253. [4] K, iv, 701. [5] K, iv, 692–3.
[6] K, ii, 642–9; iv, 703–36. [7] K, x, 843; xiv, 281.
[8] K, iv, 470–511; Boruttau, *A. Med.*, 1909, ii, 301 (305). [9] *Ib.*, 487–93.

respiration comes to the innate heat (ἐμφυτὴ θερμασία) and the blood moves to meet the air. 'The oil is the blood, the heart is the wick, the lungs the lamp or instrument.'[1] Sound is a wave in the air like that spreading from a stone dropped into still water.[2]

Post-Galenic Medicine

Later Greek writers were more concise and systematic than Galen, whom they largely epitomise; their order and conciseness is perhaps due to Roman influence. They added some new medicines and advances in surgery. Later ones were under Arabic influence.[3]

Oreibasios of Pergamos (or of Sardes in Lydia) (A.D. 325–403), physician to Julian the Apostate, was educated in Alexandria under Zeno of Cyprus. At the request of Julian he prepared an epitome of Galen and other medical authors, and of this large work, *Συναγωγαὶ Ἰατρικαί* (*Collecta Medicinalia*) in 72 books, 25 books and some fragments are extant.[4] About thirty years later he composed an extant abridgment (*Σύνοψις*), translated into Arabic by Ḥunain ibn Isḥāq (9 cent.).[5] A third work is on domestic medicine (*Εὐπόριστα*). Oreibasios quotes his authorities accurately and by name, and gives a list of materia medica (mostly from Dioskourides) in alphabetical order. Although called 'the ape of Galen (*simia Galeni*)' by Guinther, this is unjust. He opposed superstition.[6]

Nemesios, bishop of Emesa (Syria) (*c.* A.D. 400), in a work on the nature of man formerly ascribed to Gregory of Nyssa (*c.* A.D. 332–95), almost anticipated the circulation of the blood and the functions of bile. He connected psychical powers with particular structures in the body and opposed astrology.[7] Elements composing the body are in some sense opposed to one another and require certain intermediate substances to bring about their union (a sort of intermediate compound theory).[8] Nemesios believed in a kind of evolution from stones (the magnet with its 'food' iron), continuously through plants, zoophytes, animals, and finally man.[9]

Theodorus Priscianus (also called Octavianus Horatianus) flourished in Constantinople about A.D. 390 and was a pupil of Vindicianus, physician to

[1] F. Adams, (1), i, 94; Lessing, 102; Thorndike, (1), i, 143.

[2] K, iii, 644; Vitruvius, *De Architect.*, v, 3; see p. 155.

[3] Bloch, in Puschmann, (1), i, 513–68; Freind, *The History of Physick*, 1725, i, 297; *Opera*, 1733, 397; Edward Milward, see p. 202; Thorndike, (1), i, 566, 719; Wellmann, *Hermes*, 1912, xlvii, 1.

[4] Greek text and tr., *Oeuvres*, ed. Bussemaker and C. Daremberg, 6 vols., Paris, 1851–76 (BM); text ed. J. Raeder, CMG, 1926, 6 iii; *Isis*, 1929, xii, 352.

[5] L. Leclerc, i, 139–52.

[6] Bloch, in Puschmann, (1), i, 513; Greenhill, DBM, iii, 44; Guinther of Andernach (d. 1574), tr. of Alexander of Tralles, in *Med. Art. Princ.*, i, 131; Lessing, 128; E. H. F. Meyer, ii, 261; M. Neuburger, (1), i, 301; Schoell, iii, 472; Schröder, PW, Suppl. vii, 797; Sprengel, (1), ii, 185; Thorndike, (1), i, 163, 569; vi, 219.

[7] *Nemesii Philosophi & Episcopi De Natura Hominis*, ed. with notes by J. Fell, Oxford, 1617 (BM 683. g. 11); ed. C. F. Matthaei, Halle, 1802 (BM 714. e. 28); Migne, PG, 1857, xl, 503–844; English tr. by G. Wither, 12°, London, 1636; Greenhill, DBM, ii, 1152; Lessing, 132; Sprengel, (1), ii, 190.

[8] Fell, 1671, 114 f.: contraria sibi copulari non poterunt, si non esset medium quoddam vinculum quod ea colligaret.

[9] Migne, PG, xl, 504 f.

the emperor Valentinian (364–75). His Latin work, *Rerum Medicarum* or *Euposniston*, in the fourth (incomplete) book sometimes called *Physica*, contains superstitious remedies. He recommends wormseeds (*semen santonici*, containing santonin) for worms and the magnet for headache.[1] A work on diet printed with the *Physica* of Hildegard of Bingen (1532) may be by a different Theodorus.[2] Sextus Placitus, called Papyriensis or Papiensis (*c.* A.D. 360), composed a *De Medicina ex Animalibus* based on Pliny.[3]

Marcellus Empiricus of Bordeaux, archiater to Theodosius I (A.D. 375–395), completed about A.D. 400 a Latin collection of popular recipes and charms containing much superstitious material.[4] The work, *De Medicamentis Empiricis, Physicis et Rationabilibus*, is probably interpolated. Charms are to be repeated, e.g. *os gorgonis basis* $3 \times 9 = 27$ times; a phylactery to be engraved on a gold plate, which cures colic, is composed of the following letters:[5]

Λ	*Ψ*	*M*	*Θ*	*K*	*I*	*A*
Λ	*Ψ*	*M*	*Θ*	*K*	*I*	*A*
Λ	*Ψ*	*M*	*Θ*	*K*	*I*	*A*

There are descriptions of abraxas stones. Ash of a mole is mentioned; goat's blood, which alone can break diamond, is collected in a special way from a goat fed on laurel.[6] Marcellus used the *Kyranides* (see p. 247), which he thought was by Demokritos.[7] Palladios of Alexandria (4–5 cents. A.D.) wrote commentaries and a work on fevers.[8]

Aëtios of Amida (now Diarbekr) in Mesopotamia, (fl. *c.* A.D. 550), was educated in Alexandria. He wrote a medical encyclopaedia in 16 books (βιβλία ἰατρικὰ ἑκκαίδεκα), usually called *Tetrabiblos* from a later division into four sets of four books.[9] The pharmacology is mostly from Dioskourides and Galen. He introduced the medical use of cloves (καρυοφμλλον), camphor (καρφουρά, Arabic *kāfūr*), musk (μόσχος) and ambergris (ἄμβαρ).[10] St. Jerome[11]

[1] *Theodori Prisciani Euporiston libri III cum Physicorum fragmenta et additamentis Pseudo, Theodoreis. Accedunt Vindiciani Afri quæ feruntur reliquiæ*, ed. V. Rose, Leipzig (Teubner)-1894; tr. Meyer-Steineg, *Theodorus Priscianus und die römische Medizin*, Jena, 1909. Greenhill, DBM, iii, 525; Lessing, 119; M. Neuburger, (1), i, 307; Sprengel (1), ii, 177.

[2] Greenhill, DBM, iii, 1058.

[3] Fabricius, (1) (*a*), xiii, 395–423; *Med. Art. Princ.*, i, 684–97; CML, 1927, iv; Greenhill, DBM, iii, 380, 1217; Lessing, 120.

[4] *Med. Art. Princ.*, ii, 230–414; ed. Helmreich, Leipzig, (Teubner), 1889; Greenhill, DBM, ii, 936; E. H. F. Meyer, ii, 299; M. Neuburger, (1), i, 308; Niedermann, CML, 1916, vi; Sprengel, (1), ii, 180; Thorndike, (1), i, 567–8, 585–93.

[5] *De medic.*, xxix, 26; ed. Helmreich, 310; *Med. Art. Princ.*, 1567, ii, 379 (* for *Ψ* and R for *K*).

[6] Ch. 26; Thorndike, (1), i, 586–92 (some recipes differ from Pliny's).

[7] Sprengel, (1), ii, 182.

[8] *Palladii de Febribus . . . accedunt Glossæ Chemicæ et Excerptis ex Poetis Chemicis*, ed. J. S. Bernard, Leyden, 1745; Ideler, (1), i, 107–20; Bloch, in Puschmann, (1), i, 526 (Palladios Sophistes); Greenhill, DBM, iii, 95; Sarton, (1), ii, 846.

[9] Greek text (8 bks. only), Venice (Aldus), 1534; ed. A. Olivieri, CMG, 2 vols., 1935–50, 8. i–ii; Latin tr. by Jan Cornarius, *Aetii Medici Græci contractæ ex veteribus medicinæ Tetrabiblos, Sermones XVI*, f°, Basel (Froben), 1542; f°, Lyons (Beringos frères), 1549; *Med. Art. Princ.*, ii, 1–842; Adams, (1), iii, 437, 468; Greenhill, DBM, i, 53; E. H. F. Meyer, ii, 374; M. Neuburger, (1), i, 333; Sprengel, (1), ii, 200.

[10] *Tetrabiblos*, IV, iv, 113, 122; *Med. Art. Princ.*, ii, 838, 840. This is said to be the first mention of camphor: Yule, (3) (*a*), 1903, ii, 302.

[11] *Adv. Julianum*, ii, 8; Migne, PL, xxiii, 297.

mentions *muscus* among other perfumes, probably musk.[1] Aëtios describes an empyreumatic oil made by *distillatio per descensum* of oil in a pot buried in the ground and surrounded by a fire.[2]

Alexander of Tralles, in Lydia (*c.* A.D. 525–75), was eminent in Rome, Spain, Gaul, and Italy. He criticised Galen but followed him in using amulets and charms.[3] An account of him was given by Dr. Edward Milward.[4] His work *Βιβλία Ἰατρικὰ* (*De Re Medica*)[5] was written in his old age. The pharmacology is almost wholly from Dioskourides and Galen (see the index to Puschmann's edition). Opium is often mentioned, also French soap (*σάπων Γαλλικός*).[6] He does not seem to mention mercury. His *ῥέον βαρβαρικὸν* was probably not modern rhubarb.[7] Alexander mostly followed Galen but used the theory of *strictum* and *laxum* of the Methodic School (see p. 186).[8]

Problems in physics and medicine attributed to Alexander of Aphrodisias (p. 136)[9] are perhaps by Alexander of Tralles. They use the theory of atoms and pores and they also say that insects may die when immersed in oil because of the obstruction of the tracheæ.[10] Anthemios of Tralles (d. *c.* A.D. 534), the brother of Alexander, was one of the architects of St. Sophia in Constantinople. He wrote on mechanics.[11]

Paul of Aegina (Paulus Æginetus) was in Alexandria before and after the Muslim invasion (A.D. 640). His medical encyclopaedia in seven books, usually called *Notes* (*ὑπόμνηματα*) was translated into Arabic by Ḥunain ibn Isḥāq (d. A.D. 877) and had a great influence on Muslim medicine.[12] Book vii

[1] Flückiger, *Die Frankfurter Liste*, Halle, 1873, 36; Lippmann, *Isis*, 1928, xi, 171; it is in the *Talmud* (Partington, (1), 528), but there it may be an aromatic gum-resin (Löw, (1), i, 310). Lessing, 562, said musk and ambergris are first definitely mentioned, from an Arabic source, by Symeon Seth (11 cent., see p. 203).

[2] *Tetrabiblos*, Venice, 1534, 10r; Basel, 1549, 27; *Med. Art. Princ.*, i, 24 (olei suffumigabilis).

[3] Greenhill, DBM, i, 127; i, M. Neuburger, (1), i, 331; Sprengel, (1), ii, 216; Thorndike, (1), i, 566 f. (Aëtios and Alexander do not contain very much superstitious medicine.)

[4] (*a*) *A Letter to the Hon. Sir Hans Sloane Bart. in vindication of the character of those Greek writers in Physick that flourished after Galen . . . particularly that of Alexander Trallien . . .*, 1733 (BM 550. c. 13); (*b*) with new t.p., *Trallianus Revivescens; or, an Account of Alexander Trallian, one of the Greek writers that flourished after Galen: shewing that these Authors are far from deserving the imputation of mere compilers, . . .*, 1734 (BM 550. c. 14).

[5] Latin 1504, Greek 1548; *Med. Art. Princ.*, i, 129–346 (and contents, 4 ll.); ed. and tr. T. Puschmann, 2 vols., Vienna, 1878–9, and Nachträge in *Berliner Studien für classische Philologie*, 1886, v, no. 2; tr. F. Brunet, *Oeuvres Médicales*, 1933–7, vols. i, iii, iv; Bloch, in Puschmann, (1), i, 535; Freind, *Opera*, 1733, 398; Greenhill, DBM, i, 126; Hoefer, NBU (NBG), 1852, i, 915; Lessing, 165; M. Neuburger, (1), i, 328; Sprengel, (1), ii, 208; Wellmann, PW, i, 1460.

[6] Puschmann, ii, 115, 119, 545, 559.

[7] Freind, 407; Lessing, 166.

[8] Sprengel, (1), ii, 210.

[9] Sprengel, (1), ii, 216.

[10] *Problematon*, in Ideler, (1), i, 3–80; Greenhill, DBM, i, 113 (not by Alexander of Tralles); Wellmann, in Puschmann, (1), i, 482 (the author of this and of a work on fevers, *De febribus libellus*, in Ideler, (1), ii, 81–106, was a physician of the Pneumatic school, living after the 2 cent. A.D.).

[11] Louis Dupuy, *Fragment d'un Ouvrage Grec d'Anthimius sur les Paradoxes de Mécanique*, 4°, 1777; also in *Hist. Acad. Inscript.*, 1786, 72, 392–451; Berthelot, *J. des Sav.*, 1899, 242 (253); Diels, (3), 36; Greenhill, DBM, i, 184; NBU (NBG), 1853, ii, 772; Schoell, iii, 341.

[12] Greek text, Venice, 1528, Basel, 1538 (colophon dated 1543); ed. Heiberg, CMG, 1921–4; Latin tr. by Cornarius (1556) in *Med. Art. Princ.*, i, 347–749; Engl. tr. by F. Adams, 3 vols., 1844–6–7, with valuable notes; Germ. tr. by J. Berendes, *Janus*, 1908, xiii, 417, 515, 585, 654; 1909, xiv, 33, 124, 601, 689, 754; 1910, xv, 9, 73, 143, 229, 462, 534, 622; 1911, xvi, 153, 381, 492, 548; 1912, xvii, 20, 93, 233, 316, 368, 448, 557, 593; 1913, xviii, 24, 120, 210, 282, 380; and in book form; Greenhill, DBM, iii, 152; Haeser, (1), i, 463; Lippmann, (5), 141; E. H. F. Meyer, ii, 412; Sprengel, (1), ii, 222; Thorndike, (1), i, 566.

on pharmacy, with a short appendix on weights and measures, is largely from Dioskourides, Galen, and Oreibasios; it contains practically no new drugs. Many kinds of lead plasters are described.[1] Paulos[2] gives the first clear description of making caustic potash solution (*πρωτόστακτον*, 'first-decanted or drawn off') by boiling lye (*κονία*) of wood ashes with quicklime: 'the lixivium of ashes is called lye, but when the ashes have taken something from the quicklime, caustic lye is produced (*κονία τό οἷον περίπλυμα τῆς τέφρας ὀνομαζεται . . . εἰ δὲ προσλάβοι καὶ τιτάνου ἡ τέφρα, καυστικὴν ἐργαζεται τῇ κονίαν*).'

Theophilos Protospatharios of Constantinople (7 cent. A.D.), who was said to have been the teacher of the alchemist Stephanos, wrote books on anatomy and physiology, urines[3] and excrements,[4] and on physical distinctions.[5] Theophanes Nonnos (10 cent. A.D.) in an epitome of medicine mentions rose-water (*rhodostagma*), probably distilled, and a collyrium of zinc sulphate, gum arabic, and starch.[6]

Symeon Seth (d. after A.D. 1080), 'master of the palace Antiocheia' in Syria, translated from Arabic and wrote a dictionary of the medical virtues of foods[7] which contains Persian, Arabic, and Indian material. It mentions camphor (*καφουρά*), *misk* (*μόσχος*, Arabic *misk*),[8] ḥashīsh (*καvvαβουρόσπερμα*), cloves (*καρυόφυλλον*), etc. An editor of it, Monthesauros of Verona, says he himself knew how to make an artificial camphor, but preserved the secret.[9] Hierophilos (*c.* 1150), otherwise unknown, wrote a treatise on diet.[10] Demetrios Pepagomenes of Constantinople (*c.* 1270) in a work on gout is said to be the first Greek to mention senna (*σένε*) from an Arabic source.[11]

Nicholas Myrepsos ('the ointment maker') of Alexandria, physician to the Byzantine Emperor John III (1222–54), compiled a large collection of medical recipes (*Δυναμερόν, De compositione medicamentorum*)[12] based largely on Salernitan and Arabic sources. It is said to be an expansion of the *Antidotarium* written by Nicholas of Salerno, whose 140 recipes have been expanded to 2656, classified into 48 groups (including 21 salts); an abridgement by Nicholas of Reggio in Calabria (d. 1350),[13] combined with the *Antidotarium* of Nicholas of Salerno, contains 1065 recipes.[14]

[1] Bk. vii, c. 17.
[2] Bk. vii, c. 3; Adams, ii, 265, 395; Heiberg, 1924, ii, 227.
[3] *Περὶ οὔρων*; Ideler, (1), i, 261–83.
[4] *Περὶ διαχωρημάτων*; *ib.*, 397–408.
[5] *Περὶ διαφορᾶς φυσικῶν*; Ideler, (1), i, 168–83; Greenhill, DBM, iii, 1087; Lessing, 170.
[6] Gildemeister and Hoffmann, 1928, i, 27; Greenhill, DBM, ii, 1209; Sprengel, (1), ii, 249–50.
[7] *De Alimentorum Facultatibus*, ed. M. Bogdanus, 8°, Paris, 1658 (BM 450. d. 34); ed. Giraldus, *Syntagma per elementorum ordinem de Alimentorum Facultate*, Basel, 1651 (BM 539, b. 13. (1.)); another fragm. in Ideler, (1), ii, 283–5; Delatte, (1), 1–126.
[8] Adams, iii, 470.
[9] Fabricius, (1) (*a*), 1721, x, 319; Greenhill, DBM, iii, 955; G. Honigmann, *Isis*, 1930, xiv, 475; E. H. F. Meyer, iii, 356–65; Rhousopoulos, in Diergart, (1), 174; Sprengel, (1), ii, 237.
[10] Ideler, (1), i, 409–17 (cf. *id.*, i, 423; ii, 257; anon.); Delatte, (1), 454–99.
[11] *Med. Art. Princ.*, ii, 843; Adams, iii, 431; Lessing, 195; Sprengel, (1), ii, 243.
[12] Latin in *Med. Art. Princ.*, ii, 337–834 (reprint of ed. by Leonard Fuchs, Basel (also Lyons), 1549); the Greek text is still in MS. but Greek names are given in notes; list of authors quoted, Fabricius, (1) (*a*), 1726, xiii, 9.
[13] *Liber de Compositione Medicamentorum secundum loca*, 4°, Ingoldstadt, 1541 (BM 546. e. 1.).
[14] Ferguson, ii, 123, 223; Held, *Nikolaos Salernitanus und Nikolas Myrepsos*, Diss., Leipzig, 1916, and H. Lehmann, *A. Med.*, 1925, xvii, 299–306, think Myrepsos was mythical and even Nicholas of Salerno doubtful; Lessing, 196; E. H. F. Meyer, iii, 381; Sarton, (1), ii, 1094; iii, 446, 1841; Sprengel, (1), ii, 244, 359.

The work mentions petroleum, senna, mercury ointment, and some salts, including ἀλὸς ἀμμωνιακος (perhaps sal ammoniac). It does not mention distillation, which was then well known. An *aurea Alexandrina* was thought by Lessing to be an electuary containing gold, the medicinal use of gold and silver being perhaps of Arabic origin. It mentions tartar,[1] a name thought to be derived from the Persian *durd*, lees (Arabic *dūrdhia*).[2] Myrepsos recommends arsenic (αρσενικόν) as a 'spice' which counteracts poisons, a mistranslation of the Arabic *dārṣini* (Chinese cinnamon).[3]

Joannes Aktouarios (Actuarius), in Constantinople in the time of Andronikos III (1328–41),[4] composed (on the basis of Theophilos Protospatharios) a treatise on uroscopy in seven books,[5] and a treatise on diagnostics in two books,[6] which is part of a treatise on medicine (θεραπευτικὴ μέθοδος) published completely in six books (the last two on pharmacology) in Latin.[7] Although Galen knew of poisoning due to lead water-pipes (see p. 192), Aktouarios was the first to describe lead colic.[8] He belonged to the Pneumatic school, distinguishing three kinds of pneuma: natural, vital, and animal spirits.[9] In examining urines he used a glass flask (ἀμις, *matula*) divided into eleven parts, and measured the sediments. The four lowest divisions contained the deposits (ὑποστάσεων), the sixth to eighth the suspensions (ἐναιωρημάτων, mucus), the tenth and eleventh the scum or clouds (νεφελῶν, *nubes*), and the fifth and ninth intermediate constituents. He regarded urine as an excretion (περιήθημα) from the blood and gives perhaps the first description of paroxysmal hæmoglobinuria.[10] He distinguished fourteen colours of urine. He is said to be the first Greek physician to mention manna, from an Arabic source.[11] He prescribed tincture of poppies for coughs, cholera, etc., and rose-water (liquor stillatitius rosarum) then imported from Mesopotamia.[12]

Technical Authors

Apart from military engines and lifting apparatus, ancient mechanics was confined to mechanical toys, conjuring tricks, or fraudulent 'miracles' in pagan temples operated by concealed mechanisms. This tradition was developed in Constantinople, notably by Leo of Thessalonika (the Iatrosophist), professor in the Magnaura palace in A.D. 829–67.[13] In

[1] *Med. Art. Princ.*, ii, 482: species est tartari.

[2] Andreas Bellunensis, 'Arabicorum Nominum', in Avicenna, *Canon*, f°, Venice, 1608, ii, 416: thefel est faex rerum viscosarum . . . durdi et thefel sunt idem.

[3] Sprengel, (1), ii, 245.

[4] Fabricius, 1 (*a*), 1724, xii, 635 (A.D. 1100 or 1300); Greenhill, DBM, i, 17; Lessing, 197; E. H. F. Meyer, iii, 386; M. Neuburger, (1), i, 342; Sarton, (1), iii, 889; Sprengel, (1), ii, 242 (end of 13 cent.).

[5] *Περὶ οὔρων*; in Ideler, (1), ii, 3–192 (with other works on urine, anonymous).

[6] Ideler, (1), ii, 353–463.

[7] *Methodus Medendi*, tr. Mathesius, f°, Venice, 1554; bks. 5 and 6 tr. Ruellius, 8°, Paris, 1539, 1556; 8°, Basel, 1540.

[8] Alderson, *Lancet*, 1852, ii, 73, 95, 165, 202, 391, 416.

[9] Ideler, (1), i, 312–86.

[10] Ideler, (1), ii, 94: περὶ φαιῶν καὶ πελιδνῶν καὶ μελάνων οὔρων.

[11] Adams, iii, 443; Lessing, 197.

[12] Adams, iii, 544; Schelenz, 1904, 193.

[13] Constantine Porphyrogennitus, *De Ceremoniis*, ii, 15, ed. Niebuhr, Bonn, 1829, i, 569; 1830, ii, 642 (Reiske's note); Liutprand, *Historiarum*, vi, 2, in Muratori, *Rerum Italicarum Scriptores*, Milan, 1723, II, i, 469–70; G. Brett, *Speculum*, 1954, xxix, 477; Krause, *Die Byzantiner des Mittelalters, nach den byzantinischen Quellen*, Halle, 1869, 56; Partington, *Nature*, 1947, clix, 784.

antiquity inventions are usually credited to fictitious persons or to gods.[1]

Philon (Φίλων) of Byzantium, now dated *c.* 250–200 B.C.,[2] described a sympathetic ink[3]: writing with infusion of galls (κηκίς) when dry is invisible, but when sponged over with infusion of vitriol (χάλκανθον) it becomes black. A work known in fragments in Latin and more fully in Arabic[4] begins (like the work of Heron, p. 206) with a short treatise on the nature of air, and describes all kinds of mechanical and hydraulic automata. It gives an experiment of putting a flask (*amphora*) mouth downwards in water, when the water

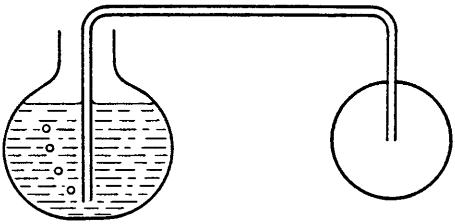


FIG. 4.

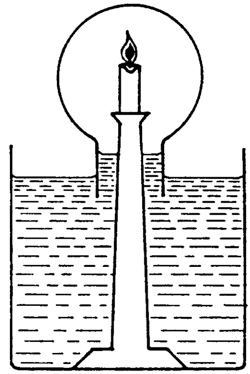


FIG. 5.

does not rise in it,[5] speaks of small air particles (ex minutissimis constare corporibus minimisque particulis),[6] and describes and figures an air thermoscope consisting of a copper or lead sphere with a doubly-bent tube soldered in it and dipping into water (Fig. 4),[7] exactly like one described and depicted by Fludd (see Vol. II, p. 326), a rather more complicated form of which was given by Heron.[8] The most interesting experiment is that in which a candle is burnt in a glass Egyptian amphora inverted over water (Fig. 5), which rises in the neck because the air is used up or dissolved by the motion of the flame, which cannot exist with it, the water rising in proportion to the amount of air which has gone:[9]

[1] Pliny, vii, 57; A. Kleingünther, *Philologus Suppl.*, 1933, xxvi, 1 (26); Partington, (4), 268.

[2] Brunet and Mieli, 487; Carra de Vaux, (1), ii, 171; Diels, (3), 203; *id.*, in Wiedemann. *Sitzb. Erl.*, 1920, lii, 189 (219); *id.* and Schramm, (1) Philons Belopoiika, *Abhl. Akad. Berlin, phil.-hist. Kl.*, 1918, no. 16 (pp. 68); (2) Exzerpta aus Philons Mechanik, *ib.*, 1919, no. 12 (pp. 84); Duhem, (1), ii, 302 (2 cent. B.C.); Feldhaus, (2), 141; Gunn, DBM, iii, 306 (*c.* 150 B.C.); Lippmann, (3), ii, 53 (the statement that Magister Salernus in Renzi, (1), 1859, v, 347, describes Philon's combustion experiment is incorrect—he refers only to a cupping glass); Orinsky, Neugebauer, and Drachmann, PW, 1941, xxxix, 53 (end of 3 cent. B.C.); Thevenot, 48–103.

[3] *Belopoiika*; Thevenot, 102 (with other methods of secret writing); Diels and Schramm, (2), 79; Pliny, xxxiv, 26; Nierenstein, *Isis*, 1931, xvi, 439; *id.*, *Incunabula of Tannin Chemistry*, 1932, 159 (detection of iron in verdigris); Hippolytos, *Refut.*, (1), 91; Partington, (1), 208.

[4] Carra de Vaux, Le Livre des appareils pneumatiques et des machines hydrauliques, par Philon de Byzance, édité d'après les versions Arabes d'Oxford et de Constantinople et traduit en français, in NEM, 1903, xxxviii, 25–235, with glossary; *id.*, (1), 1921, ii, 171 f.; Latin, and German tr., in *Heronis Alexandrini Opera quae supersunt omnia*, ed. W. Schmidt, Leipzig (Teubner), 1899, i, 460 f.

[5] Carra de Vaux, 34; Schmidt, 460.

[6] Schmidt, 464; perhaps from Straton, see p. 208.

[7] Carra de Vaux, 126; Schmidt, 474.

[8] Bk. ii, c. 8, Schmidt, i, 225.

[9] Carra de Vaux, 127; Schmidt, i, 476–8.

'quoniam aër in illo vase contentus periit propter ignis accensionem, quia non potest propter ignem duare; postquam autem perierit aër ille per motum ignis, continget quod elebavit ignis aquam secundum quantitatem illius quod peribit de aëre [je nach der Quantität Luft, welche verflüchtigt wird] . . . aër consumitur, quia inveterascit, ut ita dicam, propter ignem extenuatus [verdünnt, so zu sagen, matt und kraftlos wird].'

The experiment interested the commentators of Aristotle, who gave two explanations. Themistios said part of the air, having been changed into the nature of fire, rose upwards. Then it was followed by the body which was below it, which may be air or water. This rises into the empty space. This is also the cause of the suction in cupping glasses when fire is put in them. Alexander of Aphrodisias, however, said that after the igneous part of the air has been extinguished, the air cools and occupies a smaller space. It thus attracts the water because there cannot be a vacuum.[1]

Archimedes of Syracuse (287–212 B.C.), who studied in Alexandria, invented the method of determining specific gravity by the hydrostatic balance, which he used to detect the adulteration by silver of a gold wreath (usually called a crown) made for Hieron, king of Syracuse.[2] Archimedes was accidently killed by a Roman soldier in the siege of Syracuse; his tomb, engraved with the figure of a sphere inscribed in a cylinder to commemorate his discovery that the volume of the sphere is two-thirds that of the cylinder, was found by Cicero[3] in Syracuse, overgrown with briars. According to Arabic authors the composition of alloys was determined with the hydrostatic balance by Menelaos of Alexandria (*c.* A.D. 100) (*De cognitione quantitatis discretæ corporum permixtorum*).[4]

Ktesibios of Alexandria (*c.* 200 or 100 B.C. ?), the son of a barber, is mentioned by Pliny and Vitruvius as an inventor of hydraulic and pneumatic machines (including a fire-pump and water organ), and automata of the kind described by Heron, who is not mentioned by either. Vitruvius says the works of Ktesibios and Archimedes cannot be understood without a preliminary study of natural philosophy, so that Ktesibios was apparently a scientific author and not a mere inventor.[5]

Heron (*Ἥρων*) of Alexandria, sometimes called the elder to distinguish him from another Heron who lived under Heraclius (A.D. 610–41) and wrote on similar subjects, and from Heron of Byzantium who lived under Constantine Porphyrogennites (A.D. 905–59), is the author of several works, including (1)

[1] Duhem, in Little, (4), 241–84; Thorndike, (1), ii, 37 f.

[2] Vitruvius, ix, 3; Bruni and Mieli, 357, 363; Cajori, *History of Physics*, New York, 1929, 6; Diels, (3), 33; Donkin, DBM, i, 270; A. Heller, *Geschichte der Physik*, Stuttgart, 1882, i, 85; K. B. Hofmann, *Numismatische Zeitschrift*, Vienna, 1884, xvi, 1 (13); Hultsch, PW, ii, 507; Lippmann, (1), ii, 168; J. G. Schneider, (1), i, 449; O. Spiess, MGM, 1904, iii, 224–46; Thorndike, (1), i, 29; Wiedemann, *Sitzb. Erl.*, 1906, xxxviii, 152.

[3] *Tusc. Disput.*, v, 23.

[4] Mason, DBM, ii, 1039; Orinsky, PW, xxix, 834; H. Suter, Die Mathematiker und Astronomen der Araber und ihre Werke, in *Abhl. zur Gesch. der math. Wiss.*, Leipzig, 1900, x, 1–278 (226, note); Würschmidt, *Isis*, 1927, ix, 496.

[5] Pliny, vii, 38; Vitruvius (A.D. 55), i, 1; ix, 9; x, 12; Athenaios, iv, 75 (hydraulic organ); Bruni and Mieli, 480; Carra de Vaux, (1), 1921, ii, 170 (*c.* 100 B.C.?); Donkin, DBM, i, 899; A. G. Drachmann, Ktesibios, Philon and Heron: A Study in Ancient Pneumatics, in *Acta historica scientiarum naturalium et medicinalium*, Princeton, 1948; *id.*, *The Mechanical Technology of Greek and Roman Antiquity*, Copenhagen, 1963; Flather, DA, i, 570 (pump); Martin, *Mém. div. Sav. Acad. Inscr.*, 1854, iv, 1 (22); Orinsky, PW, xxii, 2074 (a versatile and eminent scientist and inventor); Yates and Wayte, DA, i, 984 (organ).

Pneumatica (πνευματικά, *Spiritalia*)[1] including old Hellenic, Egyptian, and Alexandrian material, (2) *Automata* (περὶ αὐτοματοποιητικῆς),[2] (3) *Cheiro-balistra* (χειροβαλλίστρας) or hand-ballista,[3] (4) *Belopoietika* (βελοποιητικά), on throwing-engines and darts,[4] (5) *Catoptrica*[5] on optical tricks with mirrors,[6] and (6) *Dioptra*; these last two were known only in Latin. Some of Heron's works on mechanics, etc., were translated into Arabic by Qusṭā ibn Lūqā (d. *c.* A.D. 912).[7] Heron's period is unknown; dates from 250 B.C. to the 3 cent. A.D. have been proposed, the most likely being about A.D. 120.[8] The *Pneumatica* consists of 78 'theorems' (experiments or tricks), the same idea being repeated in several. There are descriptions of a magic jar from which wine or water can be poured, with an air hole at the top which can be closed to prevent air passing in and liquid out, inner compartments and connecting tubes being also used; several kinds of siphons (bent, enclosed, constant discharge) are for tricks with vessels containing water and wine; a tantalus cup, mechanical singing birds, worked by air forced out by the pressure of flowing water, a hissing dragon, a whistling thrysus, automata sounding trumpets, air expanded by heat causing statues to pour libations, steam supporting a ball in mid-air or causing a pivoted copper sphere fitted with two bent jets to revolve (the first reaction turbine), inexhaustible lamps and a self-trimming lamp with a float on the oil which turns a cog-wheel pushing up the wick, a compressing air-pump, a hydraulic organ or one worked by a windmill, a cupping glass worked by the mouth sucking through a valve, and temple doors opened by putting fire on an altar, causing air to expand in a closed box below and displace water from a montejus into a bucket, which descends and unwinds cords round vertical rollers which operate the doors above the floor.[9]

[1] First published in Italian, Bologna, 1547; Latin tr. by Commandinus, *Spiritalium liber*, 4°, Urbino, 1575, and Paris, 1583; an Italian tr. by Biringuccio is in MS., C. de Waard, *L'Expérience Barométrique*, Thouars, 1936, 27; first ed. in Greek (with Commandinus's Latin tr.) in Thevenot, 145–242; *Heronis Alexandrini Opera quae supersunt omnia*, ed. L. Nix and W. Schmidt, 5 vols. and Supplement, Leipzig (Teubner), 1899–1900–1903–1912–1914; tr. J. G. Greenwood, ed. B. Woodcroft, *The Pneumatics of Hero of Alexandria*, 4°, 1851 (correcting Thevenot's text by four BM MSS. (15–16 cent.).

[2] In Thevenot, 243–74; and *Opera*, ed. Nix and Schmidt.

[3] In Thevenot, 115–20.

[4] In Thevenot, 121–44.

[5] *De Speculis*, in *Opera*, 1900, ii.

[6] Thorndike, (1), i, 193.

[7] Brockelmann, (1), 1901, 136; Carra de Vaux, *J. Asiatique*, 1893, i, 386; 1893, ii, 152, 420; *Heronis Opera*, 1900, ii.

[8] Bruni and Mieli, 492 (A.D. 100); Diels, (3), 57 (2 cent. A.D.); *id.*, *Abhl. Akad. Berlin, phil.-hist. Kl.*, 1913, no. 3, 26; Feldhaus, (1), 525; *id.*, (2), 188 (*c.* A.D. 110); Gandz, *Isis*, 1940, xxii, 263 (not after A.D. 150); Hammer Jensen, *Hermes*, 1913, xlviii, 224; Heath, *A History of Greek Mathematics*, Oxford, 1921, ii, 298–354; *id.*, *Isis*, 1924, vi, 76 (2–3 cent. A.D.); Heiberg, MGM, 1925, xxiv, 23 (1–2 cent. A.D.); Heller, *Geschichte der Physik*, Stuttgart, 1882, i, 118, 125; Hoppe, *Geschichte der Physik*, Brunswick, 1926, 16, 244; *id.*, *Hermes*, 1927, lxii, 69; *id.*, *Isis*, 1928, x, 109 (before 133 B.C.); Lasswitz, (1), i, 214 (100 B.C.); T. Martin, *Mém. div. Sav. Acad. Inscript.*, 1854, iv, 1–488; Rodwell, *Chem. News*, 1863, viii, 113; Rosenberger, i, 39; M. C. P. Schmidt, *Kulturhistorische Beiträge zur Kunde des griechischen und römischen Altertums*, Leipzig, 1906, i, 12 (an artisan of *c.* 20 B.C., from the style); Schubart, (2), 106; Susemihl, i, 737 (100 B.C.); Tittel, PW, vii, 992–1074 (end of 1 cent. B.C.); Tropfke, *A. Nat.*, 1928, x, 450 (100 B.C.); Wieleitner, *Archivio*, 1925, vi, 201; MGM, 1926, xxv, 156; *A. Nat.*, 1928, x, 239 (3 cent. A.D.).

[9] Thorndike, (1), i, 188–93.

A long section on the vacuum in the *Pneumatica*[1] may be from Straton (see p. 135). Only a few parts can be quoted here:

Some say there is absolutely no vacuum, others that there is no continuous or extended vacuum (*κενὸν ἄθρουν*, *vacuum coacervatum*), which is against nature (*κατὰ φύσιν*), but only a divided vacuum (*κενὸν παρεσπαρμένον*) which is distributed in small portions through air, water, fire, and all other bodies (*καὶ τοῖς αλλοις σώμασιν*).[2] Air is composed of minute, light, and mostly invisible bodies. An upright vessel pressed into water does not fill, since it is full of air. But if a hole is bored in the bottom of the vessel air escapes through it as wind (which is moving air), driven out by the water which enters. Diamond alone has no vacuous pores, and is not broken when hammered on an anvil.

The air particles are in contact like particles of sand but there are vacuous spaces between them. Hence when force is applied the air is compressed and, contrary to nature (*παρὰ φύσιν*), falls into the vacant spaces. But when the pressure is released the air returns to its former position from the elasticity of the particles, as horn shavings and sponges, when compressed and set free again, return to their former position and bulk.[3] By the application of force the air particles are separated and a vacuum greater than natural (*μεῖζον παρὰ φύσιν*) is produced.

The glass eggs used by doctors (*τὰ ἰατρικὰ ᾠὰ ὑέλινα*) with narrow mouths are filled with liquid by sucking the air out of them, putting a finger over the mouth, and inverting in liquid (*ὑγρον*), which, when the finger is removed, rises into the vessel. Similarly cupping glasses (*σικύα*) adhere because the fire in them consumes and rarefies the air (*φθείρι καὶ λεπτύνει τὸν ἀέρα*), as other bodies, water, air, or earth, are consumed and pass into more subtle substances (*μεταβάλλει εἰς λεπτοτέρας οὐσίας*). That something is consumed by fire is shown in the residues of charcoal (*ἐκ τῶν περιλειπτομένων ἀνθράκων*), which, although keeping the same or very nearly the same bulk as before burning (*πρὸ τὴν καῦσιν*), differ considerably in weight. The consumed parts pass away with the smoke. The flame of a lamp dying out for want of oil tends to rise to its proper region above until, overpowered by the mass of air, it becomes air itself.

An experiment (*αἰσθητικὴ ἀποδειξις*) will show that an extended vacuum, although not existing in nature, is artificially produced. Take a strong spherical metal vessel containing two quarts, bore a hole in it and solder in with tin a narrow bronze tube so as to make it air-tight, one end of the tube reaching nearly to the inside wall of the sphere and the other end projecting 2 in. outside the globe. The globe is filled with air and neither air nor water will enter it. By blowing into the tube with the mouth, more air is easily introduced, since a condensation of the particles of air in the vessel is effected by force. Again, air may be drawn out abundantly by suction, although nothing takes its place. This proves that void spaces are interspersed between the particles of the air into which, when force is applied, they fall contrary to nature. Wine mixes with water and diffuses through it, which it could not do if there were no vacua.

It may be affirmed that: (i) every body is composed of minute particles (*λεπτομερῶν σωμάτων*) between which are empty spaces smaller than the particles, and in proportion as one particle recedes another follows it and fills the vacant space; (2) there is no extended vacuum except by the application of some force; (3) the absolute vacuum is never found in nature but is produced artificially.

[1] Thevenot, 145–52; J. G. Schneider, (1), i, 209–30; Diels, *Sitzb. Akad. Berlin, phil.-hist. Kl.*, 1893, 101–27; tr. Greenwood and Woodcroft, 1–10; Farrington, ii, 31.

[2] Aristotle, *De gen. et corr.*, i, 9, 326*b*, had said it is just as absurd to postulate small (interstitial) vacua as a large one.

[3] Centuries before Boyle; see Vol. II, p. 523.

CHAPTER X

NEOPYTHAGOREANISM

Apart from its inclusion in Platonism, Pythagorean philosophy became extinct in the 4 cent. B.C. but Pythagoreanism survived as a religious life. From the 2 cent. B.C. Pythagorean science was revived in occult circles in Alexandria and S. Italy and combined with Platonic, Aristotelian and Stoic philosophies, mysticism, and Oriental elements.[1] This Neopythagoreanism, incorporating number mysticism, may contain Iranian and Indian elements, and it had an influence on the Greek-Egyptian magic papyri.[2] In Alexandria, philosophies, mysticism, and Oriental elements.[1] This Neopythagoreanism, philosophy was a scientific basis of religion.[3] Some[4] think that Neopythagoreanism arose under Roman-Italian influence; others[5] trace it back to Poseidonios. Wellmann[6] supposed that it arose in the 3 cent. B.C. in Egypt, coming from Kyrene or Lower Italy, and developed in ascetic congregations. The central idea was Greek, that union with the single eternal god Monas (*Μονάς*) can be achieved by purity of body and soul; but this was soon enveloped in Egyptian, Babylonian-Assyrian, Persian, and Jewish ideas, comprising a magic-mystical view of god, man, and nature. The resulting complex lasted into the Christian era. The literature comprised ethics and religion, scientific, agricultural, technical, medical, and magical subjects, and the Pythagorean order perhaps had laboratories in which experiments on the alloying, oxidation and treatment of metals, and distillation, were made.[7]

About 150 B.C. the order appeared in Palestine as the Essenes;[8] Eusebios calls them a Hellenistic sect. Wellmann regards Zeller's views[9] as more correct than W. Bousset's,[10] that the Essenes were not Pythagorean but under Orphic and Iranian influences. The Essenes, however, rejected number mysticism[11] and Wellmann's assumption that they were Pythagoreans was not

[1] Andres, PW, Suppl. iii, 290, 299; Bouché Leclercq, (1), 7; Frank, 68, 73, 87 f., 260, 357; Inge, (1), 1929, i, 82–8; *id.*, ERE, ix, 308; Nestle, (2), ii, 307 f.; Wellmann, PW, ix, 138; Wenley, ERE, ix, 319; Wilamowitz-Moellendorf, (1), ii, 444 f.; Zeller, (1), III, ii^4, 92, 100, 439 f.; *id.*, (2), 279.

[2] Eisler, (1), 32 f., 684 f.; *id.*, (3), 43; Heinemann, *Plotin*, 1921, 120 f., 221, 235; Nock, *J. Egy. Archaeol.*, 1929, xv, 228.

[3] Deussen, (1), II, i, 390 f.; Dill, (1), 384 f.; G. Murray, (1), 194; Renan, (1), vi, 145; Zeller, (i), III, i^4, 11 f.

[4] E. Bickel, *Philologus*, 1924, lxxix, 355; Otto, (1), 130.

[5] Schmekel, (1), 439, 474.

[6] (4)–(7); VS, ii, 211; summary in Lippmann, *Chem. Ztg.*, 1928, lii, 973; (2), ii, 39, 58; (3), ii, 101.

[7] Wellmann, (4), 16 f., 31 f., 34 f.; (5), 4 f., 9, 14.

[8] Josephus, *Ant.*, XV, x, 4.

[9] Zeller, (1), III, ii^4, 298, 325; *id.*, Zur Vorgeschichte des Christentums. Essener und Orphiker, in *Kleine Schriften*, Leipzig, 1910, ii, 120.

[10] *Die Religion des Judenthums im späthellenistischen Zeitalter*, 2 ed. (by H. Gessmann), Tübingen, 1926, 456 f.

[11] Zeller, (1), III, ii^4, 329.

always accepted.[1] Zeller[2] thought that Neopythagoreanism originated in Alexandria, the main Greek sources being Plato and Aristotle. The oldest account is that of Alexander Polyhistor (*c.* 80–50 B.C.), who used Alexandrian sources. His description suggests that Neopythagoreanism combined Pythagorean and (for the physics) Stoic doctrines.[3]

The crude forms of superstition penetrated religion and philosophy, particularly Pythagorean.[4] In place of the Peripatetic scientific treatment of animals, plants, and minerals, the doctrine of occult forces (*φύσεις*), i.e. of sympathy and antipathy, in which man, animals, plants, stones and metals were supposed to be the foci of magical powers entered from Oriental sources associated with the names of Zoroaster, Ostanes, the Magians, Dardanos the Jew, Mōchos the Phoenician, and Apollobex the Egyptian. The main propagandist was the Pythagorean Bolos of Mendes (*c.* 200 B.C.), who used works attributed to Ostanes, Orpheus (*Ἰδιοφυῆ*, *c.* 3 cent. B.C.) and Archelaos, physician of Ptolemy IV (244–205 B.C.). In quoting such sources, Pliny always says 'vulgus existimat', or 'vulgo creditur'. Bolos was what was called a *φυσικός*, for Aristotle meaning a 'natural philosopher' but in Bolos' time a magician or occultist.[5] In Hellenistic Egypt a new meaning was given to *φύσις*, viz. an occult property of an object on the basis of sympathy and antipathy, a mysterious force. Besides Greek sources, apocryphal books with recipes based on sympathy and antipathy were drawn upon to produce a literary type of *φυσικά* or *φυσικαὶ δυνάμεις* (*de rebus physicis*), the *ἀνὴρ φυσικός* being a magician.

The idea that things were connected 'by nature (*φύσει*)' with their names interpreted as numbers (written as letters of the alphabet), was familiar to the old Ionians[6] and probably of Oriental origin.[7] The numerical values of names were important even for the old Pythagoreans.[8] This number mysticism is prominent in the gnostic work of Monoimos the Arab in Hippolytos.[9] Speusippos (345 B.C.) drew up a Pythagorean table (*systocheia*) of meanings of numbers.[10] The Pythagorean number mysticism, which has little relation with scientific mathematics,[11] was taken up by Muslims.[12]

The first Roman Neopythagorean was Publius Nigidius Figulus (d. 43 B.C.), a friend of Cicero, an astrologer and mathematician, who believed in magic. He headed a secret Neopythagorean circle in Rome, consequent on the finding of Pythagorean books in a tomb.[13] Apollonios of Tyana, in Cappadocia

[1] Bauer, PW, 1924, Suppl. iv, 386; Festugière, *L'Idéal Religieuse des Grecs et l'Evangile* 1932, 73–85; W. Kroll, *Hermes*, 1934, lxix, 228–32.

[2] (i), III, ii⁴, 103 f., 114, 126.

[3] Mullach, (2), i, 413 f.; Reitzenstein, (2), 155, 275; Zeller, (1), III, ii⁴, 104 f., 148.

[4] E. Meyer, (2), iii, 332 f.

[5] Bidez, (2), i, 170 f., 258; Wellmann, (5), 3 f., 14, 42, 48 f.

[6] Ziegler, Ro. v, 1554; *A. Rel.*, 1910, xiii, 246.

[7] Chwolsohn, ii, 243.

[8] Eisler, (1), 32 f., 684 f.; (3), 43; Hopfner, PW, xiv, 339; E. Meyer, (2), ii, 370.

[9] (1), 424; Legge, (2), ii, 106.

[10] Frank, 131, 140 f., 164, 245 f., 264.

[11] Budge, (4), 427; A. Delatte, BEHE, 1915, ccxvii, 139 f., 191 f., 249 f.; Frank, 131 f., 140 f., 164, 255, 264; Inge, (1), i, 84 f.; Whittaker, (1), 37; Windelband, (1), 123, 213, 215, 237; Zeller, (1), III, ii⁴, 86, 115, 128, 140.

[12] Kraus, (2), 207–23 (an extensive bibliography omits Monoimos); I. Löw, (1), 1924, iii, 273 f.; Stapleton, *Ambix*, 1953, v, 1 f. (ψ-Jābir).

[13] Swoboda, *P. Nigidii Figuli Operum Reliquiae*, Vienna, 1889; Boll, (1), 351; Furtwängler, iii, 257; Weber, *Beih. a. O.*, 1925, iii, 71; Wellmann, (4), 15; Zeller, (1), III, ii⁴, 100.

(*c.* A.D. 17–97), a semi-charlatan accused of being a magician, who is said to have visited Babylon, Ethiopia, Egypt, and India, is known from a partly fictitious biography by Philostratos (*c.* A.D. 170–244/9), a Neopythagorean at the court of Julia Domna, the Syrian wife of the Emperor Septimius Severus. The book claims to be based on memoirs of Damis of Nineveh. The Indian travels of Apollonios have been accepted by some, but he could have got his information in Alexandria.[1] Apollonios believed in divination and necromancy, but there is very little astrology in the book. The tides are due to wind (πνεῦμα) moving the water in underground caverns, like breath in the body (v, 2). Volcanoes are caused by a mixture of bitumen (ἀσφάλτος) and sulphur (θεῖον) in the earth, which smokes by its own nature and is kindled by a wind or spirit (πνεῦμα) circulating under it (v, 17). A *Book of Wisdom* attributed to Apollonios by Eusebios (A.D. 312) is a Christian gnostic work on astrology and magic.[2] The Emperor Alexander Severus (A.D. 222–35) had a statue of Apollonios in a temple,[3] and al-Th'ālibī (A.D. 1010)[4] said his statue and those of other Greek philosophers surrounded the tomb of Alexander the Great at Babylon. In the East, under the name Balīnās, he had, before A.D. 800, an immense reputation as a magician and astrologer.

Bolos

Wellmann[5] traced Neopythagorean tradition to Bolos of Mendes and its continuation to the beginning of alchemy in the Leyden and Stockholm Papyri and ψ-Demokritos (see Chapt. 2). Bolos (Βῶλος) was born in Mendes in the Nile Delta, in Pharaonic times the chief seat of the worship of the goat-god Mendes (Pan) and celebrated for the manufacture of a perfume (*unguentum Mendesium*). It disappeared (perhaps by inundation) in the I cent. A.D. It had an old Canaanite element in the population,[6] and Souidas says Bolos wrote on the Jews (see p. 214). He was connected, in a way not clearly understood, with the name of Demokritos, and if the 'forged works of Demokritos' examined by Kallimachos (*c.* 305–240 B.C.) were those of Bolos, he must have lived at least as early as 250 B.C.[7] Wellmann thought he took the name Bolos Demokritos (many Orientals took a second Greek name) to acquire prestige. W. Kroll[8] points out that Souidas (see below, p. 214) and

[1] Greek text and tr., Philostratus, (1), (2); J. Carpentier, The Indian Travels of Apollonios of Tyana, *Skrifter Kungliga Humanistiska Vetenskaps-Samfundet i Uppsala*, Uppsala and Leipzig, 1934, xxix, no. 3; Kraus, (2), 290 f., 301; I. Lévy, BEHS, *Sci. Rel.*, 1926, xlii, 1–149 (130); Mead, (3); E. Meyer, (2), ii, 412; Miller, PW, ii, 146; Réville, (1), 200; V. A. Smith, ZDMG, 1914, lxviii, 329; Thorndike, (1), i, 242; D. M. Treadwell, *A Sketch of the Life of Apollonius of Tyana*, New York, 1886; Wilamowitz-Moellendorff, (1), ii, 486; Zeller, (1), III, ii⁴, 165.

[2] Festugière, (1), i, 340. [3] Burckhardt, (1), 180. [4] (1), 450.

[5] (4)–(7); summary in Lippmann, *Chem. Ztg.*, 1928, lii, 974; (3), ii, 101.

[6] Wellmann, (5), 9.

[7] Diels, (3), 127 (250–150, perhaps *c.* 180, B.C.); Herter, PW, suppl. v, 386; E. H. F. Meyer, i, 282; Stemplinger, 119 (*c.* 200 B.C.); Wellmann, PW, v, 138; *id.*, (4), 4 f., 8 f., 15, 16, 34; *id.*, VS, ii, 210 f.

[8] *Hermes*, 1934, lxix, 228–32; Bidez, (2), i, 118; Festugière, (1), i, 197; Hammer-Jensen, PW, Suppl. iv, 219 (ψ-Demokritos); F. Jacoby, *Die Fragmente der Griechischen Historiker*, Leiden, 1940, iiia, 8–10 (No. 263); *id. ib.*, *Comment.*, 1943, iiia, 24; Perry, PW, xx, 1074 (Physiologos); all in general agree with Kroll.

Apollonios[1] call him 'Bolos the Demokritan (Βῶλος ὁ Δημοκρείτος)'; he may have used works attributed to Demokritos but did not forge these deliberately. Later authors (e.g. Pliny) certainly called him simply 'Demokritos', but at that time 'anything could attach itself to the name of Demokritos'. He was originally a grammarian, had a keen interest in popular superstition, and was credulous, with a taste for the mystical, wonderful, and prodigious, which, with a firm belief in magic and sorcery, was characteristic of his time. His versatility was astonishing; he wrote on agriculture, sympathies and antipathies, medicine (τέχνη ἰατρική), chemistry (βαφικά), conjuring tricks (παίγνια), wonders, astrology, mantic, symbolism, history, tactics, Egyptian hieroglyphics, and ethics. He made a large collection of works of popular superstition and arranged his material into an encyclopaedia, combining Greek philosophy, Egyptian technology, and the Persian magic of ψ-Zoroaster and Ostanes.[2] Archelaos, an Egyptian poet writing in Greek in the time of Ptolemy II (308–246 B.C.), composed wonderful stories (παράδοξα) and a work on strange animals (ἰδιοφυῆ), used in Pliny's bk. 28. He mentioned the generation of bees in a putrefying animal (*bugonia*), the generation of scorpions from decaying human marrow, and the sympathies and antipathies of plants.[3] This type of literature is, therefore, anterior to Bolos, and goes back to very old Egyptian beliefs (see Poseidonios). The text of Bolos may be reconstructed from passages in Ailian, Aulus Gellius, Caelius Aurelianus, Celsus, Columella, Galen, Krateuas, Petronius, Pliny, Plutarch, the Scholiast to Nikander, Seneca, Souidas, Tatian, Vitruvius, and others.[4] Following Neopythagorean and Egyptian traditions, he pretended that some books (e.g. of Dardanos) which he used were found in tombs; some were Neopythagorean forgeries, e.g. the book on plants (περὶ βοτανῶν) of ψ-Pythagoras. He quotes his authorities in alphabetical order and probably numbered them, a new method.[5] In the O.T.[6] Solomon's wisdom exceeded that of Egypt, and he was wiser than Darda [Dardanos in LXX] son of Machol; a book on magic by Solomon is mentioned by Josephus (1 cent. A.D.).[7]

Pliny[8] says that Ostanes first wrote on magic but, Demokritos knew of Apollobeches of Coptos and Dardanos the Phoenician, whose works Demokritos found in a tomb, and based his own upon them (Democritus Apollobechen Coptiten et Dardanus e Phoenice illustravit voluminibus Dardani in sepulchrum eius petitis).[9] Wellmann[10] thought Dardanos was a Jew,

[1] VS, ii, 212.

[2] M. Cagnati, *Variarum Observationum*, Rome, 1587, ii, 7, pp. 121–5; Mullach, (1), 155; Wellmann, (4), 8, 9, 17, 20; (5), 4, 10, 14, 15, 40; (6), 63; PW, iii, 676; v, 135; Suppl. i, 255.

[3] E. H. F. Meyer, i, 271; Westermann, xxii, 158 (Lobeck, 749, dated him in the time of Ptolemy III, 246–221 B.C.).

[4] Wellmann, (4); (5); VS, ii, 210–18 (alchemical from Synkellos and Synesios, 218–20; the *Παίγνια*, 220–1; others, 221–4).

[5] Wellmann, (4), 8 f., 15; (5), 12 f.

[6] I Kings, iv, 29–34.

[7] *Antiq.*, VIII, ii, 5; Fabricius, (2) 1722, I, ii, 1014 f.; Kroll, PW, viii, 792 f.; Wellmann, (5), 12, 14; a κλεῖς (key) is a book of magic.

[8] xxx, 2; perhaps from Anaxilaos, Apion, or Hermippos; Preisendanz, PW, xviii, 1622; Wellmann, (5), 66.

[9] Wünsch, *A. Rel.*, 1911, xiv, 319, thought Demokritos wrote in tombs to get inspiration; Diogenes Laertios, ix, 38, says he frequented tombs (τοῖς τάφοις); Reitzenstein, (7), 113.

[10] *Hermes*, 1907, xlii, 614; (4), 8, 15; (5), 13, 63 f.; VS, 1952, ii, 217.

although he is sometimes called a Phrygian, and that Pliny's source was Apion's Περὶ Μάγου, or Anaxilaos. Dardanos appears with Ostanes the Persian and Apollobex the Copt in magic papyri.[1] In Greek legends, Dardanos was the ancestor of the Trojans, the founder of the mysteries of Samothrake and of magic.[2] Columella (1 cent. A.D.) speaks of the magic arts of Dardanos.[3]

Pliny[4] believed that Demokritos was the chief exponent of the art of magic. Those who admire Demokritos in other respects strongly deny that the works containing revolting and incredible material are his, but 'in vain, for it was he, beyond all doubt, who had the greatest share in fascinating men's minds with these attractive delusions'. Columella[5] and Aulus Gellius[6] distinguished Demokritos from Bolos, but Pliny confused them.[7]

The works of Bolos and similar authors contained magical recipes for curing diseases of men and animals, and madness, and peculiar properties of plants.[8] Pliny attributes some of the disgusting remedies to Ostanes, and says they were approved in certain commentaries of Demokritos which he seems to have seen. Galen[9] attributes them to Xenokrates of Aphrodisia (see p. 189) and says they were forbidden by law. Aulus Gellius[10] and Pliny[11] speak of a book by Demokritos on the virtue and nature of the chameleon (de vi et natura chamaelontis); this animal is mentioned by Aristotle[12] in the Septuagint,[13] and Galen,[14] and Alexander of Tralles (A.D. 6 cent.), in sections quoting Demokritos and Ostanes, used various preparations of it.[15] Seneca[16] says that 'Demokritos' invented the arch, the softening of ivory, and the imitation of gems, especially emeralds (quemadmodum decoctus calculus in smaragdinum converteretur).[17] Pliny[18] mentions the colouring of crystal to imitate emerald, etc., as a lucrative fraud described in books the authors of which he would not name.

Petronius[19] (Nero's time) reports that 'Demokritos' extracted the juice of every plant on earth, and spent his life in experiments (experimenta) on the extraction of the virtues of stones and twigs; Solinus[20] says he used an 'adhesive' (or 'eerie') stone (κατοχῖτις) to demonstrate the occult powers of Nature in competition with the Magi; it is mentioned by Pliny[21] as 'adhering to

[1] A. Abt, 250, 324; Dieterich *Jahrb. class. Philol. Suppl.*, 1888, xvi, 747, 752 f.; Reitzenstein, (2), 163; Wellmann, PW, iv, 2180.

[2] Schmitz, DBM, i, 940.

[3] *Rei Rust.*, x, 357–8: if no medicine can repel the plague, let the Dardanian arts be called in (he gives examples).

[4] xxx, 2.

[5] *Rei Rust.*, vii, 5; xi, 3.

[6] *Noctes Atticae*, x, 12–13.

[7] Wellmann, (5), 50 f., 63 f. Pliny repeatedly quotes 'Demokritos' (the index in Sillig's ed., Gotha, 1857, vii, 290, has a column on him), but always with some misgiving.

[8] Freeman, (1), 1948, 324; Wellmann, *Hermes*, 1907, xlii, 614.

[9] Kühn, xii, 248.

[10] *Noctes Atticae*, x, 12–13.

[11] xxviii, 29: from a book by Demokritos 'revealing the lies and frivolities of the Greeks'; E. H. F. Meyer, i, 279; Salmasius, (1), 613; Wellmann, PW, iii, 2105.

[12] *H. Animal.*, ii, 11; 503a, 15.

[13] *Levit.*, xi, 30; Lenz, (1), 431.

[14] Kühn, xiv, 427.

[15] *Med. Art. Princ.*, 156; Persian and Arabic *qalamūn*; Hell, *Ency. Islam*, i, 94.

[16] *Epist.* 90. 32 (from Poseidonios); VS, ii, 218; Susemihl, i, 866; Dutens, (1), 261; (2), 294, and Hoefer, (1), i, 85, translated *fornix* (arch) as 'reverberatory furnace'.

[17] Softening stone by beer (ζῦθος) is in ψ-Demokritos (Syriac), Berthelot, (4), ii, 176, no. 106; ivory by beer in Dioskourides, ii, 109; Maria, in Berthelot, (2), ii, 357. 22, specifies mandrake juice for softening stone.

[18] xxxvii, 75.

[19] *Satyr.*, 88.

[20] *Memor.*, iii, 4.

[21] xxxvii, 56.

the hand like gum'. Columella (d. A.D. 65) quotes Demokritos several times and distinguishes him from Bolos.[1] He says the *commenta* (ὑπομνήματα) called *χειρόκμητα* (see p. 215) attributed to Demokritos were by Bolos of Mendes.[2] He[3] quotes superstitious material from a book on antipathies (*περὶ ἀντιπαθῶν*) attributed to Demokritos and also mentioned by Tatian (A.D. 150).[4]

Souidas[5] (end of 10 cent.) has two entries on Bolos: (1) Bolos the Demokritan, a philosopher, wrote on history and the art of medicine, and cures depending on the occult force of nature. (2) Bolos of Mendes, the Pythagorean, wrote on history, marvellous things, physical remedies depending on the sympathies and antipathies of gems (arranged in alphabetical order), and the signs observed in the inspection of the sun, moon, the constellation of the Bear, lights, and the rainbow. Souidas[6] also says 'Damokritos' wrote two books on tactics and one on the Jews. It is probable that Bolos the Demokritan, and Bolos the Pythagorean and Damokritos the historian, are the same person.[7]

From the fragments Wellmann reconstructed the following works of Bolos:

1. *Βαφικά* (*Baphika*)[8]

The full title may have been *Φυσικαὶ βαφαί* or *Βίβλοι φυσικῶν βαφῶν*, but was more probably simply *Βαφικά*, like the similar work of Paxamos, a contemporary of Varro (116–27 B.C.). It was a purely technical or chemical work, not alchemical like the *Φυσικὰ καὶ μυστικά* of *ψ*-Demokritos (see p. 40), and was probably in four books dealing with gold, silver, precious stones (and pearls), and purple,[9] with recipes for their imitation. The work might be reconstructed from the Leyden and Stockholm papyri (see p. 219), into which the recipes of Bolos entered by way of an Egyptian technician for the Leyden, and Anaxilaos of Larissa (1 cent. B.C.) for the Stockholm, Papyrus.[10] Wellmann thought these recipes, 'the oldest works on chemical technology known', go back to traditions of Neopythagorean Essene workshops of the 3 cent. B.C. (see p. 209). Festugière[11] incorrectly called the contents 'alchemy'. Others[12] do not think Bolos was the source of the chemical material attributed to Demokritos in later works; Demokritos of Abdera was their reputed author. The *Baphika* of Bolos perhaps contained recipes for chemical substitutes intended for 'bourgeois' use.[13]

2. *Φυσικά* (*Physica*)

Φυσικὰ δυναμερά which Souidas (see above) called *περὶ συμπαθειῶν καὶ αντιπαθειῶν ⟨ζώιων, φυτῶν,⟩ λίθων*, 'sympathies and antipathies of ⟨animals,

[1] *Rei Rust.*, i, 1; iii, 12; vi, 28; vii, 5; viii, 8; xi, 3, 64; E. H. F. Meyer, i, 278, 282; Mullach, (1), 155; VS, ii, 212.
[2] *Rei Rust.*, vii, 5. 17; FHG, ii, 25; Susemihl, i, 482; VS, ii, 212.
[3] *Rei Rust.*, xi, 3. 64.
[4] *Address to the Greeks*, 17; ANL, iii, 22.
[5] (2), i, 1030–1.
[6] (2), i, 1169.
[7] Diels, *Sitzb. Akad. Berlin*, 1902, 1110 (no. 50); Fabricius, (1) (*b*), 1790, i, 19, 838; E. H. F. Meyer, i, 279; Mullach, (1), 156; Susemihl, i, 482; Wellmann, (4), 16; (5), 10; VS, ii, 150.
[8] Wellmann, (4), 20, 29; (5), 10, 66 f., 68; VS, 1952, ii, 218.
[9] Wellmann, (5), 67, 69.
[10] *Ib.*, 6, 8, 68, 73, 80.
[11] (1), i, 198.
[12] W. Kroll, *Hermes*, 1934, lxix, 228–32 (his date, 5 cent. A.D., for the *Physika kai Mystika* of *ψ*-Demokritos is too late); Bidez, (2), i, 118, 130; Preisendanz, PW, xviii, 1629.
[13] Rostovtzeff, (2), 1941, ii, 1225 f.

plants, and⟩ stones' (the words in ⟨ ⟩ added conjecturally by Wellmann).[1] The section on stones (in alphabetical order) may have been compiled from a lost work of Sotakos (*c.* 300 B.C.),[2] mentioned by Apollonios Dyskolos (2 cent. A.D.) and Pliny. The work is first mentioned by Kassios Dionysios Itykaos (of Utica, near Carthage), who translated twenty books on agriculture of Mago the Carthaginian in 88 B.C.[3] Pliny[4] says Pythagoras and 'Democritus' were the first Greek philosophers to adopt the opinion of the Magi on plants and give the uses of magic plants; also[5] that 'Democritus was the first philosopher to know and teach the sympathy between heaven and earth'.

Some chapters quoting 'Demokritos' in Dioskourides[6] are from Bolos, who is mentioned (*Βῶλος δε ὁ Δημοκρεῖτος ἐν τῶι Περὶ συμπαθῶν καὶ ἀντιπαθῶν*) as describing Egyptian plants in a Scholiast to Nikandros,[7] and also by ψ-Eudokia[8] and Stephanos of Byzantium (5 cent. A.D.?).[9] This part of the work of Bolos, quoting Demokritos, Orpheus, and Pythagoras, dealt with magic and superstitious botany.[10] The section on animals probably included the chameleon[11] and was used by Plutarch, Dioskourides, Aelian, Tatian, Pliny, Galen, Caelius Aurelianus, Oreibasios, Ailios Promotos, and others.[12]

The *Physica* of Bolos, reconstructed from 34 fragments by Wellmann,[13] dealt with occult force (*τὸ συμπαθητικόν, φυσικόν*) and its influence on man, animals, plants or parts of plants, and stones (perhaps including metals).[14] The *Physica* was also used by Demetrios the physician (*ὁ φυσικός*) (time of Augustus),[15] Apollodoros (1 cent. A.D.),[16] Xenokrates of Aphrodisia (*c.* A.D. 60),[17] Polles of Aigia (Asia Minor) (*c.* A.D. 100),[18] the author of the *Koiranides* (see p. 247), Neptounalios, Julius Africanus, Apsyrtos (4 cent.)[19] and Anatolios of Berytos (4–5 cent.), all used by later writers, including Theodore of Gaza (5 cent.), the author of the *Physiologos* (*c.* A.D. 400) and the Syriac *Book of Natural Things* (*c.* A.D. 600).[20] The parts on gems probably appear in Muslim and European lapidaries. The *Physica* made a great impression, especially among the semi-educated readers, and in the 1 cent. B.C. the author was regarded as the equal of Aristotle and Theophrastos.[21]

3. *Χειρόκμητα* (*Cheirokmeta*)

This work, formerly attributed to Demokritos (see p. 40), went much further in the magic-mystical direction than any previous treatise, and

[1] (5), 10 f.; VS, ii, 211; Diels, (3), 127, adds *ἀνθρώπων* [2] Wellmann, (6), 89.
[3] E. H. F. Meyer, i, 296 (Mago), 292, 301, 349 f. (Dionysios); Wellmann, (5), 10; PW, iii, 1722.
[4] xxiv, 99. [5] xviii, 68.
[6] ii, 171; iii, 52; iv, 151; Wellmann, (4), 47–8, 50, says these may be interpolations.
[7] *Ad Ther.* 764, in Nicandros, ed. Schneider, 1816, 109.
[8] *Violarium*, ed. Flach, Leipzig (Teubner), 1880, 161.
[9] Stephanus Byzantinus, 4 vols., Leipzig, 1825, i, 91; *s.v.* *ἀψυνθος*; *βῶλος ὁ Δημοκρήτειος*.
[10] A. von Haller, *Bibliotheca Botanica*, Zürich, 1771, i, 14, 132; E. H. F. Meyer, i, 277 f.; Susemihl, i, 482.
[11] Wellmann, (5), 27 f.
[12] Wellmann, (5), 10, 16 f.; VS, ii, 211 f., 215–18. [13] (5), 18–28.
[14] Wellmann, (4), 21; (5), 9 f.; on *φυσικά* literature, Marrou, BEFR, 1938, 136 (143).
[15] Wellmann, (5), 3, 48, 52, 66. [16] *Ib.*, 3, 14, 48.
[17] *Ib.*, 3, 44 f., 48, 51. [18] *Ib.*, 4, 12, 30. [19] E. H. F. Meyer, ii, 336.
[20] Ahrens, (1); Wellmann, (5), 4, 29 f., 45, 48; MGM, xvi, 374.
[21] Wellmann, (5), 28; Weidlich, PW, Suppl. i, 4.

included Iranian magic (Zoroaster and Ostanes), Phoenician-Jewish superstition (Dardanos), Egyptian magic (Apollobex), and Chaldaean astrology,[1] and was arranged in numbered sections or in alphabetical order. Vitruvius[2] explained that 'Democritus' called his *De rerum natura volumina et ejus commentarium* by this name, since he sealed with a ring on wax what he had confirmed by experiment (in quo utebatur annulo signaretur amolcic est expertus). Pliny[3] thought the work was genuine; his quotations show that it dealt with magic plants.[4] The full title may have been χειρόκμητα καὶ φυσικὰ δυναμερὰ (the actions of artificial and natural forces).[5] Chemical writers seem to have understood χειρόκμητα as 'manual operations' or 'things done by hand'. Synesios,[6] although not using the word, speaks of the chemist operating on matter by changing its form as by a carpenter, stonemason, or statuary, and Zosimos[7] says 'there are expounded the numerous arts of every kind which can be found of these (operations) done by hand, these experiments which are called χειρότμητα' (*sic*).

Thucydides and Plutarch use ἐγχείρησις,[8] and a work on 'practical anatomy ('Ανατομικαι ἐγχειρήσεις)' was written by Galen.[9] Goethe, in his *Faust*, called chemistry 'Encheiresin Naturae', in the sense of 'Kunstgriff', probably from his teacher Spielmann,[10] who probably derived it from Libavius.[11]

Apollodoros of Kzikos (? time of Tiberius, 42 B.C.–A.D. 37) is mentioned by Diogenes Laertios[12] as a Demokritan. Pliny says he added to the Chirocmeta (χειρόκμητα) of Demokritos (Bolos) the sensitive plant (*aeschynomenen*) and the *crocis* (? the fly-trap).[13]

4. Γεωργικά (*Georgika*)

This work on agronomy, viniculture, bee-keeping, etc., combining agriculture with medicine, magic, and the theory of sympathy and antipathy, may be reconstructed from fragments in the *Geoponika* (see p. 222),[14] Ibn al-'Awwām (*c.* A.D. 1200) (who calls the author Dīmāqrāthis al-Rūmī),[15] etc. Juba, king of Mauretania (*c.* 50 B.C.–A.D. 23), used by Pliny and others, wrote in Greek on many subjects, including botany and zoology, with superstitious material.[16] Kassios Dionysios of Utica, writing in Greek, translated in 88 B.C. the Punic work of Mago of Carthage (date unknown) on agriculture, and also

[1] Eisler, (3), 181.
[2] ix, 3; ed. Krohn, 1912; the MSS. have different spellings, χειρόκμητα being an emendation of Salmasius, (1), ii 775, based on Pliny, xxiv, 102; Fabricius, (1) (*b*), 1791, ii, 640; LSJ, 1985 (neuter plural, 'wrought by hand'); Mullach, (1), 127; Oder, *Rhein. Mus.*, 1890, xlv, 58 (70).
[3] xxiv, 102.
[4] E. H. F. Meyer, i, 277; Susemihl, i, 301, 482, 856, 902, 907; ii, 674.
[5] Diels, *Sitzb. Akad. Berlin*, 1902, 1101 (no. 50); MGM, ii, 226; (3), 1924, 128, 134 f.; Wellmann, (4), 8. The adjective χειρόκμητος is used in the sense of 'artificial' by Aristotle, *Phys.*, ii, 1, 193*a* (χειροκμήτων); *Meteor.*, II, i, 353*b*. 25; IV, iii, 381*a*. 31; Stephanides, 'Αθηνᾶ, 1905, xvii, 54–9 (56); as contrasted with φυσικά, 'natural'.
[6] Berthelot, (2), ii, 62; Hoffmann, in Ledenburg, (1), 1884, ii, 516.
[7] Berthelot, (4), ii, 239; pref. to book η'. [8] LSJ, 475. [9] Kühn, ii, 215 f.
[10] *Institutiones Chemiæ*, Strasbourg, 1763; 2 ed. 1766, 8: Natura plures noverit encheireses substantias; Lippmann, (1), ii, 439; (4), 100.
[11] *Alchemia*, 1597, 2: ἐγχείρησις, quasi manus artificiosè admouendæ descriptionem nomines, dicatur.
[12] ix, 38.
[13] Freeman, (1), 1948, 335; Pliny, xxiv, 102; VS, ii, 246; Wellmann, (5), 3, 14, 48.
[14] Fabricius, (1) (*a*), 1714, vi, 507; Wellmann, (4), 19 f., 42–58.
[15] E. H. F. Meyer, iii, 149, 260; Wellmann, (4), 17, 20, 42 f.
[16] E. H. F. Meyer, i, 317–24; Wellmann, (5), 40 f., 49.

composed a treatise on roots (ῥιζοτομικά) much used by Pliny.[1] Juba, and a Didymos the agronome frequently quoted in the *Geoponika*, were the main sources for the *Physica* of the agronome and grammarian Pamphilos of Nikopolis in Syria (*c.* A.D. 100),[2] who was a source for Ailian (beginning of 3 cent. A.D.).[3] Sextius Niger (*c.* A.D. 50), who wrote in Greek, called by Pliny[4] 'a most careful enquirer into the nature and history of medicinal substances', was preferred by Galen to Dioskourides. The *Georgika* was perhaps used by Cato (*De Agri Cultura* (*c.* 160 B.C.). Fragments in Dioskourides are probably from Sextius Niger and Krateuas.[5]

Neptounalios (or Nepoualios) (*c.* A.D. 120) wrote a *Physika* in the form of letters, fragments of which are in the *Kestoi* of Julius Africanus (3 cent. A.D.)[6] and the *Geoponika*. It gave 86 short examples of sympathies and antipathies of animals, plants, and stones, mostly from the *Physika* of Bolos, through Pamphilos. There are fragments in the *Hexaëmeron* of Ambrosius (A.D. 337/40–397).[7] Nepoualios is named as the author of a work on antipathy and sympathy.[8] Wellmann[9] said it did not use Aelian (as Gemoll, who edited the work, supposed) but either Didymos or (more probably) Anatolios. The authorship of Neptounalios is now generally assumed.[10] A work of the same title is attributed to Zoroaster in the *Geoponika* (xv, 1). Bidez and Cumont[11] think Bolos and Pamphilos used a *Περὶ φύσεως* of ψ-Zoroaster, *c.* 270–80 B.C. in four books mentioned by Souidas; although Bolos never mentions Zoroaster, Pliny[12] calls 'Democritus' (Bolos) a 'Magorum studiosissimus', and his account of magic plants in alphabetical order is probably from Pamphilos. Asklepiades of Prusa (see p. 185) also used Bolos.[13] Zoroaster is quoted in the *Geoponika*. The lapidary in one book (*Περὶ λίθων τιμίων α'*), attributed by Souidas to Zoroaster, quoted by Pliny, Solinus, and other authors, may be the dictionary of stones (*Λίθων κατὰ στοιχεῖον*) by Bolos mentioned by Souidas.[14]

5. *Παίγνια* (*Paignia*, literally 'sport')

Twelve conjuring tricks attributed to 'Demokritos' are contained in a 3-cent. magic papyrus.[15] One recipe is to make copper (or bronze) look like gold by

[1] E. H. F. Meyer, i, 257, 290, 292, 296, 301, 349; Wellmann, (4), 31; PW, iii, 1722.
[2] Bidez, (2), i, 116; E. H. F. Meyer, ii, 23, 137 f., 142, 256; Wellmann, (5), 3, 32 f., 40, 48; (6), 19; Wendel, PW, xviii, 336.
[3] *On the Nature of Animals*, ed. J. G. Schneider, Leipzig, 1784, Hercher, Paris, 1858, and 2 vols., Leipzig, 1864–6; Schmidt, in Christ, 1913, ii, 621; Thorndike, (1), i, 322; Wellmann, (5), 39 f., 45, 48; PW, i, 486; it contains superstitious material and includes Indian animals.
[4] xxxii, 13.
[5] E. H. F. Meyer, ii, 44; Wellmann, *Hermes*, 1889, xxiv, 530; (4), 26, 34–41; (5), 48.
[6] Thevenot, 301.
[7] Kroll, PW, xvi, 2335; E. H. F. Meyer, ii, 284; Oder, *Rhein. Mus.*, 1893, xlviii, 1; Thorndike, (1), i, 482.
[8] Rentdorf, in Fabricius, (1) (*a*), 1711, iv, 295–367 (301); E. H. F. Meyer, ii, 260. Rentdorf attributed it to Anatolios, the master of Iamblichos; Graves, DBM, i, 161.
[9] (5), 29–32; PW, v, 138; Suppl. i, 225; VS, 1952, ii, 215.
[10] Festugière, (1), ii, 422; W. Kroll, PW, xvi, 2535.
[11] Bidez, (2), i, 107 f., 112 f., 117 f.; ii, 140.
[12] xxiv, 102; Bidez, (2), ii, 167.
[13] Pliny, xxvi, 9; on magic plants, following an account of Asklepiades and mentioning 'Democritus'.
[14] Berthelot, (1), 166; Bidez, (2), i, 128 f.; ii, 140, 197 f.
[15] BM CXXI; Kenyon, (1), i, 89; Freeman, (1), 1948, 325; Hopfner, PW, xiv, 393; Preisendanz, PGM, ii, 7; VS, ii, 220; Wessely, (1), no. 2.

cleaning it with a mixture of sulphur and chalk (πὰ χαλκᾶ χρυσᾶ ποιῆσαι φαίνεσθαι: θεῖον ἄπυρον μετὰ τῆς κρητηρίας μείξας ἔκμασσε); others deal with painting eggs to look like apples, and prescriptions for aphrodisiacs. The recipes were used by Hippolytos,[1] the *Geoponika*,[2] Psellos,[3] and ψ-Albertus Magnus (*De Mirabilibus Mundi*).[4]

6. *Medical works*

Some are attributed to 'Democritus' by Celsus[5] and Caelius Aurelianus (5 cent. A.D.?).[6] They were probably contained in a treatise Τέχνη ἰατρική by Bolos.[7] Apollonios in his book *Marvels* says Bolos quoted Theophrastos on the plant wormwood (*apsinthion*) as a preventive against bile disease among sheep in the Pontos who ate it (probably because the bitter plant counteracted the bitter bile).[8] Oros (Ὦρος) of Mendes quoted by Aëtios (6 cent.) as the inventor of a drug with nine ingredients,[9] may have been Bolos; Galen[10] quotes Orpheus and Ὦρος of Mendes as using white lead for internal use.

Apocryphal medical works of Demokritos (*Ephemerides*, *Prognostica*, *Tabula*) were translated into Latin in Lower Italy about A.D. 700, and a medical collection attributed to him, containing rational as well as superstitious remedies, was in use in the 9 cent.[11] Superstitious material in Arabic works by al-Rāzī (*Continens* and *De rebus physicis*), Avicenna (*Canon* and *De physicis ligaturis*), Ibn Zuhr (*c.* A.D. 1100), Ḥunain ibn Isḥāq (9 cent.), Qusṭā ibn Lūqā (9 cent.), and the *De Mirabilibus Mundi* of ψ-Albertus Magnus uses the *Koiranides* of Hermes Trismegistos, Neptounalios, Archigenes, Galen, Alexander of Tralles, Josephus, Anatolios, Timotheos of Gaza (*c.* A.D. 500) and an Athursofos or Athuriscus (Xenokrates ?), all going back ultimately to Bolos.[12]

ANAXILAOS

Anaxilaos of Larissa (in the 'wonderland' of Thessaly) visited Rome about 40 B.C. as a propagandist for Neopythagoreanism, but was expelled in 28 B.C. as a magician (γόητες), and probably went to Alexandria, where he composed mystical and magical works which seem to have had the same titles as those of Bolos: *Physika* (Φυσικά), *Paignia* (Παίγνια), and *Baphika* (Βαφικά), and were

[1] *Refut.*, iv, 29. [2] xiv, 8, 'Democriti'; ed. Niclas, 1781, iv, 996.
[3] Westermann, 146. 25. [4] Wellmann, (4), 29 f.
[5] *De Med.*, ii, 6; ed. Paris, 1821, i, 4, 96.
[6] *Morb. Acut.*, III, xiv, 112; xv, 120; xvi, 132, 137; *De Morb. Tard.*, IV, i, 4; (1), 371, 377, 385, 388, 817.
[7] Mullach, (1), 155; Wellmann, (5), 10, 43.
[8] VS, 1952, ii, 251; Theophrastos, *H. Plant.*, IX, xvii, 4; Stephanos Byzantinos, Leipzig, 1825, i, 99; the quotation from Theophrastos in Apollonios (Ἱστορίαι θαυμάσιαι, 31, Westermann, 111) does not mention Bolos, but Wellmann, (4), 15, says the work is an excerpt from a Θαυμάσια of Bolos, since it names him at the start: Westermann, 103.
[9] VS, ii, 251.
[10] Kühn, xiv, 144; Susemihl, i, 130.
[11] Heeg, *Abhl. Akad. Berlin, Phil.-hist. Kl.*, 1913, no. 4; *id.*, MGM, xiv, 276; Sudhoff, MGM, xiv, 315; *id.*, *A. Med.*, 1915, ix, 79 f., 111.
[12] Wellmann, (5), 16 f., 30.

perhaps revisions of them. They contain some original material. A book on magic by Anaxilaos quoted by Irenaios[1] is probably his *Paignia*. A few fragments are given by Psellos (*c.* A.D. 1000), through Julius Africanus.[2] Pliny[3] quotes them for magic tricks (especially magic candles), perhaps by way of Apion.[4]

Pliny[5] quotes Anaxilaos as saying that *hippomanes* from a mare when burnt on the wick of a lamp gives an illusion of horses' heads, and if thrown on molten metal the statue cast from it has magic properties; also that if ink of the sepia is put in a lamp, the light makes those seen by it look as black as Ethiopians. These magic lamps and candles turn up regularly in mediaeval collections of experiments.[6]

Anaxilaos probably dealt with the imitation of precious metals, gems, and dyes (as in the Leyden and Stockholm chemical papyri), and was perhaps used by Simon Magus (1 cent. A.D.) for tricks such as making fire come from water (see p. 254);[7] by the gnostic Markos (*c.* A.D. 150) for chemical tricks (see p. 268); by Loukian (A.D. 180) in his description of Alexander Abonoteichos (see p. 277); by Julius Africanus (d. *c.* A.D. 240) in his *Kestoi* (see p. 220); and by Hippolytos (d. A.D. 235) in his description of magicians' tricks (see p. 251).[8]
A recipe of 'Demokritos' given by Anaxilaos[9] specifies a mixture of salt, alum, and vinegar for 'making silver' from copper, and the writer mistrusted it, since he says: ἐλένξει τὸ ἀποβησόμενον ἡ πεῖρα (what comes of it must be tried). The *Leyden Papyrus* gives anonymous recipes using salt and alum,[10] and attributes one with salt, alum, and vinegar to Phimenas of Sais[11] who perhaps used Anaxilaos. Bidez and Cumont[12] doubt Wellmann's assumption that *all* Pliny's citations from the 'Magi' come from Bolos through Anaxilaos.

Paxamos

A follower of Bolos was Paxamos (1 cent. B.C.), who wrote on cookery and, according to Wellmann, on metals, false gems, and dyes. He was almost certainly Egyptian.[13] He is quoted in the *Geoponika* (xii, 17; xx, 6). The alchemist Zosimos (*c.* A.D. 250) refers[14] to the 'divine Paxamos' on 'the roasting of the bird (ἡ τοῦ ἰθμητοῦ ὀρνιθίου ἕψησις)' by the heat of sublimation and an appropriate liquid; in later alchemy 'the bird of Hermes' or 'the eagle'

1 *Contr. Hæres.*, i, 13; ANL tr., 51.
2 Westermann, 143 f., 148.
3 xix, 4; xxv, 95; xxviii, 49; xxxi, 47 (elenchus); xxxv, 50.
4 M. Cagnati, *Variarum Observationum*, Rome, 1587, iii, 10, pp. 213 f.; Preisendanz, PW, xviii, 1622; Wellmann, (5), 52 f., 66 f., 74, 76, 78 f. (Pliny, Africanus, etc.); Stemplinger, 16; Zeller, (1), III, ii[4], 112 f., 122.
5 xxviii, 49; xxxii, 52; Mizaldus, *Memorabilium Centuriæ IX*, Cologne, 1573, 168 *r*.
6 Thorndike (1), i, 88, 469; ii, 231 (Kiranides), 345 (William of Auvergne), 561, 736, (Albertus Magnus), 782 (*Liber Vaccae*), 786 (Marcus Graecus), 800.
7 Wellmann, (5), 54 f., 80.
8 Wellmann, (5), 57 f., 77–80 (fragm. of A.); (6), 56 f.; Lippmann, *Chem. Ztg.*, 1928, lii, 974 (=*id.*, (3), ii, 101).
9 *Stockholm Papyrus*, α', 13; Lagercrantz, (1), 3, 149.
10 Chs. 10, 19, 85; Berthelot, (3), 30, 33, 45.
11 Ch. 84; Berthelot, (3), 45.
12 Bidez, (2), i, 120, 130.
13 E. H. F. Meyer, ii, 205, 252; Morel, PW, xviii, 2436; Susemihl, i, 842; Wellmann, (4), 19; (5), 12, 54 f.
14 Berthelot, (2), ii, 138. 9; iii, 140.

meant sublimation of the hermetic mercury.[1] Paxamos is quoted by Athenaios[2] as his favourite author on cookery. Athenaios[3] quotes Krateua, a woman druggist (ἡ φαρμακοπωλῃ) and cook; and Sikon, who taught his pupils physical knowledge and military science as preliminaries to the divine art of cookery (τῆς τέχνες ἔσπευδε ταῦθ' ἥμας μαθεῖν) and was in no respect inferior to the physicians in impudence. Another cook called salt 'sea sediment (ἀτάς θαλός)' and used other unintelligible words;[4] another spoke of warm vapour (πνοή) rising from the frying pan.[5]

Africanus

Julius Africanus (the name 'Sextus', given only by Souidas as 'Sektos', is doubtful) was born about A.D. 160–80 in Ælia Capitolina, founded by Hadrian on the ruins of Jerusalem. Jews were forbidden to enter the city and Africanus was certainly a Christian, although the story that he was bishop of Emmaeus (Nikopolis), where he lived and probably died about A.D. 240, is given only by late Syriac authors. He travelled extensively, seeking the remains of Noah's ark on Mount Ararat, and hence perhaps he was wrongly called a Babylonian.[6] He was on good terms with the emperor Alexander Severus, perhaps as an engineer officer.[7] He wrote a *Chronography* in five books, fragments of which are preserved by Eusebios, and a *Kestoi*, containing magic and superstition, so that some older authors distinguished a Julius of Palestine and a Sextus of Libya; but they, and a veterinary author Africanus, are the same person.[8] In the *Chronography* he gives[9] the story of the fallen angels as in the Book of Enoch. He attempted to reconcile the accounts of Matthew and Luke on the genealogy of Christ, and in a letter to Origen disputed the genuineness of part of the Book of Daniel.[10]

Souidas[11] says the *Kestoi*, in 24 books, dealt with magic etc. It included scientific (agrarian), medical, military and other subjects, and much superstition. The name κεστοί probably refers to the embroidered magic girdle of Aphrodite (κεστὸς ἱμάς)[12] and the dedication to Alexander Severus (A.D.

[1] [Salmon], *Dictionnaire Hermetique*, Paris, 1695, 5 (Aigles), 142 (Oyseau des Sages: c'est le Mercure Philosophique; et lors qu'ils parlent de leurs Oyseaux, ils entendent leurs sublimations); see also the emblematic birds in Barchusen, *Elementa Chemiæ*, Leyden, 1718, 502 f.

[2] *Deipnos.*, ix, 19; Salmasius, (1), ii, 917.

[3] *Deipnos.*, iii, 69. [4] *Ib.*, ix, 29. [5] *Ib.*, iii, 71.

[6] Bidez, CMAG, vi, 19. Souidas calls him a Libyan.

[7] Berthelot, (4), i, 95, 374; Duchesne, i, 333, 411; ii, 63; Fabricius, (1) (*a*), 1712, v, 268; 1714, vi, 506; (1) (*b*), 1795, iv, 240; H. Gelzer, *Sextus Julius Africanus und die Byzantinische Chronographie*, 2 vols., Leipzig, 1880–98; Harnack, (1), 269, 411; H. Köchly and W. Rüstow, *Griechische Kriegsschriftstaller*, Leipzig, 1855, II, ii, 5; Kraus, *Mém. Inst. Égypte*, 1942, xlv, 62; D. G. Krüger, (1), 156; Lippmann, *Chem. Ztg.*, 1928, lii, 973; T. Martin, *Mém. div. Sav. Acad. Inscr.*, 1854, iv, 1 (337); E. H. F. Meyer, ii, 220; J. Niclas, *Geoponicorum*, Leipzig, 1781, I, xlv; Partington, (4), 6; Salmon, DCB, i, 53; Schubart, (2), 171; Smith, DBM, i, 56; A. H. J. Vincent, NEM, 1858, xix, II, 407; Wellmann, (4), 30 f.; (5), 1, 54, 69 f., 77; (6), 15, 35 f., 48, 53, 97 f., 110.

[8] Gossen, PW, viii, 1714; Kroll and Sickenberger, PW, x, 116, 121; Wellmann, (5), 69–70, 76.

[9] ANL, 1869, ix, 172.

[10] Salmon, DCB, i, 54; ANL, 1869, ix, 163 f.

[11] (2), i, 904–5: 'Αφρικανός. ὁ Σέκτος φιλόσοφος Λίβυς κεστοι βιβλ. κδ' (24) δὲ οἱονει φυσικά ἔχοντα ἐκ λόγων τε καὶ ἐπαοιδῶν καὶ γραπτῶν τινῶν χαρακτήρων ἰασεις τε καὶ ἀλλοίων ἐνεργειῶν; ANL, ix, 163. Photios, *Bibl. codex*, § 34, ed. Bekker, Berlin, 1824, p. 7, says it was in 14 books.

[12] Homer, *Iliad*, xiv, 214–15.

222–235) fixes the date as later than the *Chronographia* (A.D. 220/1).[1] The Greek text was printed by Thevenot[2] from a Paris MS. (16 cent.), Meursius from a 10-cent. Florence MS.[3] collated with a Leyden and several Paris MSS., and J. R. Veillefond.[4] A fragment of book 18 in a 3-cent. papyrus[5] contains magic elements.

Conring,[6] Reinesius[7] and Fabricius[8] all thought Africanus wrote on chemistry. The present text of the *Kestoi* does not mention it but is incomplete; book 3 dealt with purple[9] and chemical parts may have been lost. The recipe for 'automatic fire' (see below) is an interpolation not earlier than the 6 cent. Although living in Jerusalem, Africanus (in the extant fragments) does not name the alchemist Maria the Jewess (2 cent.). Wellmann[10] thought the *Kestoi* contained recipes free from mysticism, copied in part from the *Baphika* and the work on Sympathies and Antipathies of Bolos of Mendes (*c.* 200 B.C.) and Anaxilaos (*c.* 100 B.C.), and a source for the Leyden and Stockholm Papyri, the latter[11] mentioning an 'Afrikianos' twice. Synkellos (9 cent.) said[12] the *Kestoi* dealt with medicine, magic, agriculture, and alchemy (χυμευτικῶν; Lambeck has χυμικῶν): Riess[13] thought Synkellos had the work of Africanus before him but the passage may have been taken from a work of Panodoros, *c.* A.D. 400. Scaliger[14] quotes it (with χυμικῶν) as in the *Canon Chronicle* of Eusebios (A.D. 260–340), but it is not in the extant Latin translation (*c.* A.D. 350–400),[15] and it is not in the Armenian translation.[16] It was probably added from Synkellos by Scaliger.[17]

Africanus is frequently quoted in the *Geoponika*,[18] but according to E. Fehrle[19] not in the Syriac, Armenian, and Arabic (from the Persian) translations, which are probably based on older Greek texts. Medical recipes from the *Kestoi* assembled by Psellos (*c.* A.D. 1000)[20] include plants and vegetable

[1] Jülicher, PW, vi, 1377; Jacoby, *ib.*, 1570; A.D. 217, E. Meyer, (1), I, ii, 12; Krüger, 154.
[2] 275–316; notes and *variae lectiones* by Boivin, 340–59.
[3] Meursius, *Opera*, Florence, 1746, vii, 899–984.
[4] *Jules Africain. Fragments des Cestes provenant de la Collection des Tacticiens Grecs*, Paris, 1932.
[5] Grenfell and Hunt, *Oxyrhynchus Papyri*, 1903, iii, 36 (no. 412); Preisendanz, PGM, ii, 150; Hopfner, PW, xiv, 301; Nock, *J. Egy. Archaeol.*, 1929, xv, 222.
[6] (1), 20 f.
[7] (1), 352; *id.*, in Cyprian, (1), 88 f.; Fabricius, (1) (*a*), 1724, xii, 754; CMAG, 1932, iv, 387 f.
[8] (1) (*a*), 1724, xii, 775: qui in cestis suis etiam chemica attigit.
[9] Wellmann, (5), 70. [10] (5), 1, 54, 69 f., 77.
[11] Lagercrantz, (1), 32, 37, 106, 216, 226.
[12] *Chronographia*, ed. Goar, Paris, 1652, 359; Venice, 1729, 286; ed. Dindorf, Bonn, 1829, 676; Thevenot, pref. xiii; VS, ii, 218–21; Fabricius, (1) (*a*), 1714, vi, 178; Kopp, (2), i, 41; Lambeck, (1), 1781, vii, 425.
[13] PW, i, 1341.
[14] *Thesaurus Temporum. Eusebii . . . Chronicorum libri duo . . . opera ac studio J. J. Scaligeri*, Leyden, 1606, 70: *των χρονικῶν κανόνων . . . Ευσεβιου του Παμφιλου τὰ σωζόμενα.*
[15] *Eusebii Pamphili Chronici Canonis*, ed. J. K. Fotheringham, London, 1923, mentioning Africanus several times, e.g. p. 296: Iulius Africanus, Olymp. CCL.
[16] Hoffmann, in Ladenburg, (1), 1884, ii, 521.
[17] Conring, (1), 21: ex Syncelli monumentis plærumque tantum per conjecturam solegerit. Hoffmann translated δυνάμεις χυμευτικῶν as 'the force of chemical preparations', but δυνάμεις seems to belong to φυσικῶν, and γεωργικῶν (E. H. F. Meyer, ii, 221) refers to the magic virtues of plants.
[18] Ed. Niclas, 1781, iv, 1275 (index); Wellmann, (4), 30, 32.
[19] *Studien zu den griechischen Geoponikern*, Leipzig, *Στοιχεῖα*, 1925, ii, 2 f., 25.
[20] Lambeck, (1), 1781, vii, 422, 471; Westermann, (1), 143–8.

products, lead, tin, litharge, arsenic sulphide (σανδαράχη), sulphur, alum, vitriol, strong vinegar, and various gems; Teukros of Babylon (the astrologer)[1] is quoted. An old author says Africanus had 'a divine Book of Cheops'.[2]

The present text of the *Kestoi* has a recipe for 'automatic fire',[3] probably added about A.D. 550:

> 'Automatic fire (αὐτόματον πῦρ) is composed of equal parts of native sulphur, rock-salt, incense, and thunderbolt stone or pyrites, ground in a black mortar in the mid-day sun, and mixed with equal parts of resin of the black sycamore and liquid asphalt of Zakynthos to a greasy paste. Then some quicklime is added. The mass is stirred at mid-day with care and the body protected, since the composition easily inflames. It is kept in brass boxes with tight covers, protected from the rays of the sun until it is wanted. If the engines of the enemy are to be burnt, they are smeared with it in the evening, and when the sun rises all will be burnt.'

Ailios Promotos of Alexandria (*c.* A.D. 200), a physician, wrote a *Δυναμερόν* or *Φυσικὰ δυναμερά* quoting magic recipes from Bolos and Xenokrates.[4] Gargilius Martialis (*c.* A.D. 230)[5] wrote on the medical virtues of fruits and plants. Florentinos, about the same time,[6] often used in the *Geoponika*, had similar interests. Apsyrtos of Prusa or Nicomedia in Bithynia (*c.* A.D. 333), a veterinary surgeon[7], wrote in the form of letters. Vindanianos Anatolios of Berytos (Beirut) (4–5 cent.)[8] wrote a *Συναγογὴ γεωργικῶν ἐπιτηδευμάτων* in 12 books, and Didymos of Alexandria (4–5 cent.) a *Georgika* in 15 books, with a magical-mystical tendency, and a medical work in 8 books (Ὀκτάτομος) containing magic recipes (φυσικά).[9]

The Geoponika

The *Geoponika* (*Γεωπονικα*), frequently quoted above, is a compilation in 20 books made by Cassianus Bassus (6 or first half of 7 cent. A.D.) from Anatolios and Didymos, enlarged to its present form in the time of Constantine Porphyrogennetos (A.D. 905–959).[10] It quotes 44 authors.[11] It was translated into Syriac, Armenian, and Arabic, and is often cited by Arabic authors, e.g. Ibn al-'Awwām (end of 12 cent.).[12] An Arabic translation was made directly from the Greek by Sarjjis ibn Hiliya (extant in Leyden MSS.), and one from a Pahlavi version called *Warz-nama*.[13] The chapter on sympathies and antipathies (xv, 1) probably goes back to Bolos.[14] 'Demokritos' (Bolos) is

[1] Bouché Leclercq, 224, 227. [2] E. Meyer, (1), 1913, I, ii, § 234.
[3] Thevenot, 303; Meursius, 954; Veillefond, 62; Hopfner, PW, xiv, 391 f.; Partington, (4), 8.
[4] Greenhill, DBM, i, 29; Wellmann, *Sitzb. Akad. Berlin*, 1908, 772; *id.*, (5), 4, 31, 56.
[5] E. H. F. Meyer, ii, 177, 228 f.; Wellmann, (4), 33. [6] E. H. F. Meyer, ii, 218 f.
[7] *Geoponika*, xvi, 1, 3–8, 19, 21 (rational treatments); Wellmann, (5), 4, 33.
[8] Baumstark, (1), 171; E. H. F. Meyer, ii, 258; Wellmann, (5), 40, 48; (4), 17; PW, iii, 1667.
[9] Cohn, PW, v, 472; Haller, *Bibliotheca Botanica*, 1771, i, 127 f.; Wellmann, PW, v, 445; *id.*, (5), 4, 39 f., 47 f.
[10] Latin tr. (J. Cornarius), *Constantini Caesaris selectarum praeceptionum de agricultura libri xx. Addito indice uberrimo*, 8°, Basel, 1540 (CUL Hhh. 166); Greek text: *Geoponicorum*, ed. J. Needham, 8°, Cambridge, 1704; *Geoponicorvm sive De Re Rustica Libri XX*, ed. J. N. Niclas, 4 vols., Leipzig, 1781 (with Latin tr. and index); *Geoponica sive Cassiani Bassi Scholastici De Re Rustica Eclogae*, ed. H. Beckh, Leipzig (Teubner), 1895. Fehrle, 49; W. Gemoll, *Untersuchungen über die Quellen, den Verfassern und die Abfassungszeit der Geoponica*, 1883; Gossen, PW, viii, 1714; E. H. F. Meyer, iii, 345; Oder, *Rhein. Mus.*, 1890, xlv, 58, 212; 1893, xlviii, 1; *id.*, *Philologus Suppl.*, 1899, vii, 231; PW, vii, 1221.
[11] Fabricius, (1) (*a*), 1714, vi, 506. [12] E. H. F. Meyer, iii, 260; L. Leclercq, ii, 109.
[13] Ruska, *A. Nat.*, 1913, vi, 306; *Islam*, 1914, v, 174. [14] Wellmann, (4), 28 f.

quoted for the 'doubling (*diplosis*)' of vinegar (viii, 41) and changing new wine into old (vii, 24: 'Damogeron'). Others deal with the artificial colouring of fruit and flowers (x, 15, 19; xi, 18. 13); bleaching flowers with fumes of burning sulphur (20. 1 f.); the testing (δοκιμασία) of wine for keeping (VII, xv, 16) (plates of lead, tin, and copper should remain bright in it); testing of vinegar for water by adding soda (νίτρον), which froths if water is present (viii, 40); and testing wine for water (vii, 8) by adding quicklime, which slakes (διαχύσει) if water is present, but if the wine is pure it stays in a lump (πήξει). These chemical experiments are probably old, since Pliny[1] mentions that a lead plate changes colour (mutatus in eo colos) in wine beginning to turn bad. There are recipes for mixtures (containing sulphur, pyrethrum, etc.) for driving away serpents, but a simpler method is to write the name of Adam on the four corners of a dovecote (XIII, viii, 4). Oder showed that the names given at the beginning of the sections are not always those of the true authors. A theory[2] of cosmic winds produced by the stars and different from local currents of air, referred to 'Demokritos' but may be old Chaldaean.[3]

PLUTARCH

Plutarch (Ploutarchos), of Chaeronea in Boeotia (*c*. A.D. 46/48–120), resided in Athens and Rome and visited Corinth, Sardes, and Alexandria, but lived mostly in his native town. He was very well informed but usually left his material without deciding in favour of any particular view. He was essentially a Platonist but was influenced by Aristotle and the Neopythagoreans (hence he is considered here) and opposed the Epicureans and Stoics.[4] He shows some approach to gnosticism.[5] His philosophical and scientific works, called *Moralia*, were probably composed about A.D. 100.[6] His *On Isis and Osiris*[7] reproduces some old Egyptian information but many of his interpretations are incorrect.[8] He used a work attributed to the Egyptian historian Manetho (4–3 cent. B.C.) but compiled in the 2–1 cent. B.C., and another by the same or another *ψ*-Manetho on the Egyptian perfume κῦφι.[9]

The stars are gods and below them are demons.[10] The unchangeable law (εἱμαρμένη) of the universe, established by god, compels certain results from certain actions, but not the actions themselves.[11] Matter is real. In the begin-

[1] xiv, 25. [2] I, xii, 3, 12; Bidez (2), Cumont, i, 123.
[3] Kroll, *Hermes*, 1930, lxv, 1. Van Helmont's *blas*: *Ortus Medicinæ*, Amsterdam, 1652, 65 (Blas meteoron); Pliny, ii, 38–9, distinguished this *ventus* from local *flatus*.
[4] Bigg, 81; Dill, (1), 401; (2), 97; R. Hirzel, *Plutarch*, Leipzig, 1912; Long, DBM, iii, 429; Thorndike, (1), i, 200; Ueberweg, (1), i, 532 (A.D. 45–125); Verbeke, 260–86; Zeller, (1), III, ii[4], 173; Ziegler, PW, XXI, i, 636–962.
[5] Bigg, 29, 79.
[6] Ed. Wyttenbach, 8 vols., Oxford, 1795–1830; ed. Deubner, Paris (Didot), 2 vols., 1841; ed. Bernadakis, 7 vols. and Excursus, Leipzig (Teubner), 1888–96; ed. Paton, Weghaupt, and Hubert, Leipzig (Teubner), 4 vols., 1925–38; tr. P. Holland, *The Philosophie, commonly called the Morals*, f°, 1603, revised 1657; *Morals*, W. W. Goodwin, 5 vols., Boston, 1870: some works are spurious.
[7] Ed. Parthey, *Über Isis und Osiris*, with tr. and notes, 1850; tr. Meunier, Paris, 1924; tr. Mead, (1), i, 261–366; ed. and tr., with notes, T. Hopfner, *Monographien des Archiv Orientální*, Prag, 1940, ix.
[8] Scott-Moncrieff, *J. Hellenic Stud.*, 1909, xxix, 79–90.
[9] Schmitz, DBM, ii, 915; on κῦφι, Ganszyniec, PW, xii, 52–4; Partington, (1), 169.
[10] Andres, PW, Suppl. iii, 301. [11] Zeller, (1), III, ii[4], 196.

ning of the universe there was a chaotic arrangement of pre-existing matter in which the five elements (including ether) were present in germ. Matter is not evil but passive, a female principle, capable of receiving good and evil active influences.[1] The elements are represented by the five regular solids, but ether is sometimes (as with the Stoics) identified with fire. There are probably five worlds, each composed of a pure element. The soul (ψυχή) differs from spirit (νοῦς) and is divided into five parts.[2] The oracles, which are natural, appear where springs or vapours rise from the earth and act as a stimulus to the soul.[3] Hermes is the logos and identical with the Egyptian god Thoth; Isis is passive and material (ὕλη), a capacity for good; Typhon is the evil principle (identical with the Persian Ahriman).[4] The Egyptians concealed knowledge in myths and there are sacred symbols.[5] The physical and chemical information in Plutarch's writings is mentioned in appropriate places.[6] The treatise on the names of rivers and mountains, containing superstitious material on gems and plants,[7] is spurious. It has been attributed to Parthenios, who taught Virgil Greek,[8] and was printed with a similar work by Psellos (*Περὶ λίθων δυναμέων, de lapidum virtutibus*).[9]

[1] Zeller, (1), III, ii^4, 187 f. [2] Zeller, (1), III, ii^4, 197 f. [3] *Ib.*, 213 f.
[4] Zeller, (1), III, ii^4, 213 f. [5] *Isis and Osiris*, 2, 3, 11, 46, 67.
[6] See Lippmann, Chemical and Technological References in Plutarch, *Ambix*, 1948, iii, 1–14 (the references were mostly added by the present writer).
[7] *Morals*, tr. Goodwin, 1870, v, 477; Thorndike, (1), i, 215.
[8] C. W. King, (1), 1883, 9. [9] Toulouse, 1615 (BM 686. b. 14).

CHAPTER XI

NEOPLATONISM

The last school of Greek philosophy, Neoplatonism, began in the 3 cent. A.D. and continued until the school at Athens was closed by Justinian in A.D. 529. Its influence lasted for much longer, first in the East, where it was absorbed into Muslim philosophy, and later in the 15-cent. Platonic revival in Italy. The originator of Neoplatonism was Ammonios Sakkas of Alexandria (*c.* A.D. 175–242), at first a Christian, who worked as a porter and baker. He wrote nothing but his ideas are given by his pupils.[1] His main object was to reconcile Plato and Aristotle. He taught that the soul is united to the body without undergoing any change of its essence (κατ' οὐσίαν ἀλλοιοῦσθαι), as intimately combined as a compound (κρᾶσις) of wine and water, in which they retain their characteristics (ἀμφότερα συνδιαφθείρει).[2]

PLOTINOS

Plotinos, born at Lykopolis in the Delta in Egypt in A.D. 204/5, studied under Ammonios for ten years. He joined the expedition of Gordian to Persia in 242–3, hoping to learn something of Eastern thought, but was disappointed. He settled in Rome in 245 as a teacher and the centre of an intellectual circle. He tried to found a Platonic community in Campania. There is no doubt that he was a man of the highest intellectual and moral eminence. He died at Puteoli in Campania in 269–70. His pupil Porphyry, who says Plotinos wrote nothing before A.D. 255, arranged his works (about A.D. 300–5) in 54 chapters in six *Enneads* of groups of nine.[3] Plotinos had some knowledge of Christianity and may (before Porphyry) have attacked it.[4] Porphyry[5] names Adelphius,

[1] Cohn, PW, i, 1863; Ueberweg, (1), i, 594–5.

[2] Deussen, (1), II, i, 482; Freudenthal, PW, i, 1863; Heinemann, *Hermes*, 1926, lxi, 1; Windelband, (1), 218; Zeller, (1), III, ii⁴, 506.

[3] Plotinos, *Opera*, ed. F. Creuzer and G. H. Moser, 3 vols. 4°, Oxford, 1835 (with Latin tr and notes); reprinted (giving pagin. of 1835 ed.), Paris (Didot), 1855 (with Proklos, *Institutio Theologica*, pp. li–cxvii); ed. H. F. Müller, 3 vols., Berlin, 1878–80, and German tr., 2 vols., 1878–80; French tr., Bouillet, 3 vols., Paris, 1857–61; E. Bréhier, text and tr., Paris (Budé), vols. I–VI i, ii, 1924–38; Baeumker, 402; Bigg, 181; Buonaiuti, 102; Brade; E. R. Dodds, *Select Passages illustrating Neoplatonism*, 1923; A. Drews, *Plotin*, Jena, 1907; Eunapios, (1), 353; F. Heinemann, *Plotin. Forschungen über die plotinische Frage*, Leipzig, 1921; Hoefer, NBG, 1862, xl, 487; Inge, (1); H. F. Müller, *Dionysios, Proklos, Plotinos*, BPM, 1918, xx; Nestle, (2), i, 134; ii, 311; P. V. Pistorius, *Plotinus and Neoplatonism*, Cambridge, 1952; Porphyry, Life of Plotinos, in H. F. Müller, *Die Enneaden des Plotin*, 1878, i, 3–24; A. Richter, *Neoplatonische Studien*, Halle, 1867; Schwyzer, PW, 1951, xli (2), 471–592; Tennemann, vi, 29–203, 376–493; Thorndike, (1), i, 298; Ueberweg, (1), i, 596; Whittaker, (1), 27–106; Zeller, (1), I, i⁷, 224; III, ii⁴, 520.

[4] Inge, (1), 1929, i, 64, 108; Mozley, DCB, iv, 18; C. Schmidt, Plotins Stellung zum Gnosticismus und kirchlichen Christentum, TU, 1910, v, no. 4, 60, 85.

[5] *Life of Plotinos*, c. 16.

Aquilinus, and Nikotheos (also mentioned by the alchemist Zosimos, see p. 271) as Christians living (in Rome) in Plotinos's time. Plotinos[1] says the gnostics (αἱ νόσοι composed charms, ascribed diseases to demons, and believed in astrology; he protested against 'the tragedy of terrors (τραγῳδίας τῶν φοβερῶν) which they think exists in the spheres of the universe'.

Neoplatonism aimed at the reconciliation of Plato and Aristotle (a fundamentally hopeless task), but although in general critical of Stoicism it also included Stoic elements (e.g. the notions of νοῦς, ψυχή, φύσις and ἕξις — see pp. 50–123); a link between later, more mystical, Stoicism, and the more rational parts of Neoplatonism is discernible. All its characteristics may be traced to earlier Greek systems.[2] In the 2 cent. Neoplatonism revived interest in Plato's writings.[3] It absorbed Neopythagoreanism, both being connected with mystery cults; Jewish influence, including Philo, was slight,[4] Egyptian could hardly be avoided, since 'the real cradle of Neoplatonism was not Athens but Alexandria' (Inge),[5] Iranian influence (which appeared with Plato) is not improbable,[6] and some Indian influence is possible.[7] Gymnosophists (Jains?) and Buddhists were in Alexandria in the time of Plotinos.[8]

The penetration of Greek philosophy by Babylonian, Iranian, late Egyptian, and Jewish elements, which began with Poseidonios, is discernible in earlier Neoplatonism, and increased later.[9] Plotinos criticised the Stoics for their materialism and the Epicureans for everything in their philosophy, but he and his followers adopted the Stoic doctrine of 'sympathy' (see p. 162); the whole of being is connected by a 'Platonic chain'. The universe is like a lyre; when one string vibrates, the others sound in sympathy.[10] Plotinos was averse to magic and superstition. Although he believed that the stars could foretell destiny in some cases, he denied that they could rule it.[11] The commands of the gods were executed by demons, who swarmed everywhere.[12]

The Neoplatonists as a body were ascetic and of nervous temperament; the miracles which they claim to have experienced or seen, when they were not fraudulent, were probably the results of autosuggestion.[13] Ralph Cudworth (1617–88), the leader of the 'Cambridge Platonists', after careful consideration concluded that oracles, miracles, witchcraft, possession, prophecies, and

[1] *Enn.*, II, ix, 13 f.; Whittaker, (1), 87.
[2] Barth, 287; Dodds, (1), xviii, 203; Festugière, (1), iii, 59; Inge, (1), 1929, i, 82, 110; *id.*, ERE, ix, 308; H. F. Müller, *Hermes*, 1914, xlix, 70; Porphyry, *Life*, cc. 14 (Stoic and Peripatetic, especially Aristotle's *Metaphysics*), 20 (Pythagorean); K. Praechter, *Hermes*, 1922, lvii, 481 (515); Vacherot, (1), i, 336; Verbeke, 351; Zeller, (2), 290.
[3] Festugière, (1), iv, 92.
[4] Deussen, (1), II, i, 481; Heinemann, 1921, 189, 192 f., 205, 228; Heinze, 298; Inge, ERE, ix, 308.
[5] Cumont, *Culte égyptienne et le mysticisme de Plotin*, 1922; Inge, (1), 1929, i, 81; *id.*, ERE, ix, 308; Whittaker, (1), 13, 62, 83.
[6] Andres, PW, Suppl. iii, 316; Heinemann, 1921, 235.
[7] Burckhardt, (1), 181, 220; Deussen, (1), II, i, 485 (doubtful); Garbe, (1), 85 f., 99 f.; Heinemann, 1921, 221; Radhakrishnan, ii, 52; Simon, (1), i, 205.
[8] H. I. Bell, (4), 5; Bréhier, *Plotin, Ennéades*, 1924, I, xv f.; Clement of Alexandria, *Strom.*, i, 15; Hippolytos, *Refut.*, i, 24; Inge, (1), 1929, i, 82; ii, 29, 117, 192; Zeller, (1), III, ii^4, 324.
[9] Hopfner, (1), xiv f., xvii, 202.
[10] Deussen, (1), II, i, 504; Inge, (1), 1929, I, xiii, 254; Whittaker, (1), 100 f.
[11] *Enneads*, II, iii, 1–16; Bouché Leclercq, 599.
[12] Andres, PW, Suppl. iii, 311; Bouché Leclercq, 600, 604; Inge, (1), 1929, ii, 197.
[13] Hopfner, (1), 212.

apparitions were caused by invisible spirits, 'real and substantial inhabitants of the world';[1] he also[2] quotes Psellos as saying that mediums could talk in languages such as Armenian which they could not understand, and Cudworth himself knew a young man who talked in Latin and Greek in this way. The Neoplatonic emphasis on ascetic life (from the Pythagoreans) was also a feature in Christian monasticism.[3]

For Plotinos, magic and sorcery are due to the sympathy between natural objects, even at a distance,[4] but a good man is not affected by them. Plotinos suffered no harm from the magic arts of his enemy Alexandrinos Olympios, who tried to direct sidereal enchantments against him, of which Plotinos was aware.[5] The superstitious elements in Neoplatonism are Greek.[6] Porphyry[7] tells of a ceremony in a temple in Rome when an Egyptian sorcerer invoked the demon of Plotinos, who was present, but a god appeared; it could not be questioned since the assistant, who held some birds (used in magic) by the necks, strangled them, and the apparition vanished. Porphyry says Plotinos achieved union (ἕνωσις) with the god four times when he was with him; Porphyry achieved it only once. The study of demonology passed from Plato to Xenokrates, Poseidonios, and Plutarch, and to the Neoplatonists, in passing only with Plotinos, in more detail in Porphyry, and in full flood in Iamblichos.

The division into ἄγγελοι, δαίμονες and ἥρωες (angels, demons, heroes) goes back to Celsus (reported by Origen). These 'divine souls' (θεῖαι ψυχαί) were for Proklos the immanent world-soul, the souls of the seven planets and the fixed stars, the souls of the 'gods below the moon' (descended from Gē and Ouranos),[8] and lastly human souls. Animals and vegetables have only 'images of souls (εἴδωλα τῶν ψυχῶν)'.[9]

Plotinos taught that everything which is owes its existence to a supreme principle, the One, from which everything descends in a decreasing order of goodness until the process is terminated in matter, as light is extinguished in darkness. Each intermediate step has something of those on each side of it:

τὸ ἕν *to hen*; the One or the highest principle	→	{νοῦς *nous*, intelligence {ἰδέαι *ideai* the world of ideas	→	ψυχή *psyche*, the soul	→	ὕλη *hyle*, matter

Nothing in the series of the first three (i.e. apart from matter) can lapse in production; producing causes and their effects in every grade have always existed and always will (οὐδὲν ἀπολεῖται τῶν ὄντων).[10] The world soul is the logos (λόγος), particular souls are λόγοι σπερματικοί, as with the Stoics.[11]

The primary being (τὸ πρῶτον), the One (τὸ ἕν), is without limit, form, or definition (τὸ ἄπειρον). Exalted above all, it cannot communicate itself

[1] Cudworth, iii, 28.
[2] *Ib.*, ii, 657 f.
[3] Burckhardt, (1), 218 f.; Inge, (1), 1929, ii, 164 f. (Orphic).
[4] *Enneads*, IV, iv, 31, 40–44; IV, ix; Dieterich, (1), 152; Merlan, *Isis*, 1953, xliv, 341; Thorndike, (1), i, 299.
[5] Porphyry, *Life of Plotinos*, c. 10.
[6] Bouché Leclercq, 22 f.
[7] *Life of Plotinos*, cc. 10, 23.
[8] Plato, *Tim.*, 40E.
[9] Burckhardt, (1), 217; Dodds, (1), 295.
[10] Deussen, (1), II, i, 497; Inge, (1), 1929, i, 189; ii, 70; Whittaker, (1), 54 f., 94.
[11] Inge, (1), 1929, i, 125, 156 f., 205–10; ii, 37 f., 49, 91; cf. B. Russell, 313.

substantially and cannot be divided. In deriving every order of being from it, Plotinos resorted to analogies. He sometimes speaks of 'emanation (ῥεῖν, ἀπορρεῖν)' in a metaphysical sense; he compares production with light coming from the sun (περίλαμψις, ἔλλαμψις), which shines without apparently suffering any loss; or with light reflected in a mirror; or illumination with a central source of light, which lights up successive regions until it is finally lost in the darkness of matter; or with the spring of life in the root of an immense tree; or with an overflowing spring of water. The idea may have come from Poseidonios;[1] it was foreshadowed by Plato[2] but first clearly expressed by the Middle Stoics.[3] Philo and Plotinos differed from Plato in assuming that the divine mind contains the ideas, Plato regarding the ideas as existing outside the mind of the demiurge; Plotinos differed from Philo and the Gnostics by treating as mythical a creator fashioning things from pre-existing matter according to a pattern.[4]

By contemplation of itself (ἐπιστροφή) the One produced Intellect (νοῦς, *Nous*).[5] Nous emanated the World Soul, this a second soul. Nature (φύσις), which is combined with the body of the world as the human soul with its body. The world soul creates and comprehends a plurality of particular souls, reaching to the limit of the suprasensual world.

The soul is in one sense divisible in various parts of the body, but in another indivisible, because it is a whole in each part, and remains unmixed in union with the body. Thus the sympathy (συμπάθεια) uniting things is explained; each part 'hangs' on what precedes it; also the doctrine of the microcosm (man contains in himself the principle of all things);[6] 'all things that are in heaven (ἐκεῖ) are also on earth'.[7] After death, the soul enters other bodies, to pass round the wheel of birth.[8]

Plotinos rejected the Stoic doctrine that the soul is *in* the body as a material part; rather, the body is in the 'field' of influence of the soul. In Scholastic terminology it is *forma emergens a materia* rather than *forma immersa in materia*.[9] It is the actuality (ἐνέργεια) or reality (οὐσία) of the body.[10] A Latin translation of Plotinos by Victorinus (4 cent.) was probably used by St. Augustine, whose mention of 'spiritum autem et vivere et vivere facere' is perhaps the earliest reference to a 'vital force'.[11]

A further descent of the divine force reaches into the imperfect region of matter, which as non-being and deprivation is evil, not simply by privation but by nature. Yet some substrate of the intelligibles (νοητὴ ὕλη) in the higher stages must be recognised.[12] Matter as a source of evil, and a 'ladder of

[1] Ueberweg, (1), i, 598 f. [2] *Tim.*, 42E.
[3] *Wisdom of Solomon*, vii, 27 (under Stoic influence, *c.* 100–50 B.C.); Dodds, (1), 213 f., who adds Philo, Seneca, ψ-Aristotle *De Mundo*, etc., and says the representation of reality as a chain of spiritual forces (δυνάμεως) is characteristic of Neoplatonism.
[4] Whittaker, (1), 35. [5] Inge, 1929, ii, 37 f.
[6] Deussen, (1), II, i, 496 f.; Whittaker, (1), 44 f., 65; Zeller, (1), III, ii[4], 553, 619.
[7] Inge, ERE, ix, 311.
[8] Deussen, (1), II, i, 502; Inge, (1), 1929, i, 86; ii, 29 f., 243 (παλιγγενεσία, although μετεμψύχωσις occurs in Proklos); Whittaker, 95.
[9] *Enneads*, IV, iii, 22; Inge, (1), 1929, i, 218; Verbeke, 358; Zeller, (1), III, ii[4], 635.
[10] The word ὁμοουσίας, 'of one essence' (not 'of one substance') occurs in Plotinos and gnostic works quoted by Hippolytos: W. Scott, (1), ii, 34.
[11] H. Meyer, *Geschichte der Lehre von den Keimkräften von der Stoa bis zum Ausgang der Patristik*, Bonn, 1914, 215; Lippmann, (4), 18.
[12] Deussen, (1), II, i, 494–9; Ueberweg, (1), i, 605.

perfection', are not found in Plato.[1] The soul looks at that which does not look at it, at darkness, and hence arises evil matter.[2] Evil is necessary, since the world is composed of opposites, of form and of matter.[3] There is life in matter, even in stones.[4] The earth is a great animal[5] and the four elements are parts of it.[6]

The principle (ὑποκείμενον) of bodies is matter (ὕλη), which is real but is not a thing since it lacks form;[7] it is like dark empty space, which receives forms by union with the seminal reasons (*logoi spermatikoi*), emanations from the divine logos, mystically called Hermes.[8] It is the aspiration to exist, not absolutely nothing (οὐκ ὄν) but not a thing (μὴ ὄν); it is 'next to nothing', a phantasm of mass (φάντασμα δὲ ὄγκου), a 'decked-out corpse' (ἀλλὰ νεκρὸν κεκοσμημέον).[9] The material world exists because creative power could not stop at intelligibles but goes to the limit (ἔσχατον) of existence.[10] Whittaker[11] supposed that Plotinos believed that matter is indestructible; Inge[12] that his ὕλη is not matter in our sense, 'material existence', but an incorporeal (ἀσώματος) subject of energy, constant only in change. Space is the last of all things, since it is made by bodies.[13]

Porphyry

Porphyry tells us[14] that he was born in A.D. 233 in Tyre, joined Plotinos in Rome in 262/3 and stayed with him; that his own name was Malchos (Malek), meaning 'King', so that he was nicknamed 'Basileus' (King) and then 'Porphyrios' (the purple) by his teacher Longinos in Athens. St. Jerome and Chrysostom say that he was born in Batanea in Palestine. He worked mostly in Rome and died about 305.[15] Besides editing Plotinos's *Enneads*, he composed many works (Bidez gives 77 titles) on philology, theology, astronomy, embryology (formerly attributed to Galen), rhetoric, the history of philosophy, against Christianity (*Κατὰ Χριστιανῶν*) in 15 books (condemned to be burnt in 448 but many fragments remain), and a commentary (*Εἰσαγωγή*) on Aristotle's *Categories* which was a standard text-book in the Middle Ages.[16] He quoted his authorities and was more systematic but less original than Plotinos. He was perhaps the first to use the 'higher criticism', contending that the Book of Daniel was late and that works attributed to Zoroaster were forgeries. Although more favourable towards demonology, mythology, and pagan religion than Plotinos, he was comparatively sober minded and was

[1] A. E. Taylor, (2), 455; (3), 11.
[2] *Enneads*, I, viii, 3–4. [3] *Ib.*, I, viii, 8. [4] *Ib.*, VI, vii, 11. [5] *Ib.*, IV, iv, 22.
[6] *Ib.*, IV, vii, 11; Plotinos says Plato taught that 'fire is a soul', but Plato did not say this.
[7] Baeumker, 404 f.; Inge, (1), 1929, i, 128 f.; Tennemann, vi, 119 f., 143.
[8] Deussen, (1), II, i, 499; Heinze, 303 f.; Inge, ERE, ix, 310; *id.*, (1), 1929, I, xii, 128; Whittaker, (1), 68, 71.
[9] *Enneads*, II, iv, 1–16; Inge, ERE, ix, 310.
[10] Deussen, (1), II, i, 500; Whittaker, (1), 64, 81; Zeller, (1), III, ii[4], 550, 598.
[11] (1), 68 f. [12] (1), 1929, I, xii, 128 f.
[13] *Enneads*, V, v, 9; VI, viii, 11. [14] *Life of Plotinos*, cc. 4, 17, 20, 21.
[15] J. Bidez, (3); L. Holstenius, *De Vita et Scriptis Porphyrii*, Rome, 1630, and in Fabricius, (1) (*a*), 1711, iv, 207–81.
[16] *Porphyrii Opuscula*, ed. Nauck, 2 ed. Leipzig (Teubner), 1886.

respected by most Christian writers.[1] Porphyry wrote on abstinence from animal flesh (he believed that animals have souls and reason, but confined the transmigration of souls to human beings) and was more ascetic than Plotinos.[2] He believed in an intermediate pneumatic vehicle (πνευματικὸν ὄχημα) between the body and the soul, surrounding the soul as a luminous envelope or astral body, and acquired during its descent through the astral spheres. There is also a luminous envelope surrounding the world soul. This reappeared as an inferior part of the soul in Iamblichos and Proklos, and in St. Augustine as the *pars mundana* or *pars spiritalis*.[3]

Porphyry began the system of triads developed later by Proklos (p. 232); an intelligible triad is: being (τὸ ὄν), intelligence (νοῦς), and life in itself (τὸ αὐτόζωον); essences which owe their being to the simplicity of their substance are imperishable.[4] The corporeal is compressible, the incorporeal incompressible and real, body being only an appearance.[5] In his time superstition flourished.[6] His belief in demons (perhaps under Persian influence) went further than Plotinos's.[7] He followed Plotinos in saying that the stars indicate but do not determine fate and their motion influences the sublunary world.[8] Divination (μαντική, *divinatio*) was old in Greece in all kinds of forms.[9]

The name *theurgy*[10] (θεουργία) for a sacramental rite was introduced by Porphyry[11] and later became a predominant part of Neoplatonism;[12] Porphyry was opposed to crude superstition (see p. 232). Porphyry[13] speaks of a 'double death' (*mors duplex*); one, which is known to all men, separates the body from the soul (τοῦ σώματος ἀπὸ ψυχῆς), whilst the other, which is sought by the philosophers, separates the soul from the body (τῆς ψυχῆς ἀπο τοῦ σώματος). The idea appears in Arabic works on alchemy[14] and is related to the Qabbalistic *mors binsica* (see Vol. II, p. 217). The Neoplatonists were familiar with Mithraism, a gnostic element which is mentioned by Celsus[15] and Porphyry (from Euboulos).[16]

[1] Bigg, 294; Deussen, (1), II, i, 506; Duchesne, i, 402; Tennemann, vi, 203–47; Ueberweg (1), i, 609–12; Vacherot, (1), ii, 12; Whittaker, (1), 107; Zeller, (1), III, ii⁴, 693–735. An early work of Porphyry, Περὶ τῆς ἐκ λογίων φιλοσοφίας, is quoted several times by Eusebios.
[2] Whittaker, (1), 113 f., 116 f.
[3] Hopfner, (1), 236; Tennemann, vi, 410; Verbeke, 364 f., 370–8, 384.
[4] Vacherot, (1), ii, 39–42. [5] *Ib.*, ii, 18 f.
[6] Burckhardt, (1), 256; Inge, (1), 1929, i, 25–70; Soltau, 46 f., 153. See various authors in ERE, iv, 775–830 (divination); ix, 591 (palmistry), 444 (occultism); x, 122–39 (possession), 362–76 (prodigies and portents); xii, 120 (superstition).
[7] Andres, PW, Suppl. iii, 311, 316 f.
[8] Bouché Leclercq, 601; Riess, PW, ii, 1825.
[9] Creuzer, (1), i, 185–95; Hopfner, PW, xiv, 1258; Thorndike, (1), i, 60 f.
[10] Bouché Leclercq, 599; Hopfner, PW, 1936, II Reihe, vi, 258.
[11] Augustine, *Civ. Dei*, x, 9–10.
[12] Bouché Leclercq, 599; S. Eitrem, La Théurgie chez les Neo-Platoniciens et dans les Papyrus Magiques, *Symbolae Osloensis*, 1942, xxii, 49; Hopfner, PW, xiv, 379; *id.*, PW, II Reihe, vi, 258.
[13] *Sententiae*, ix; ed. Mommert, Leipzig (Teubner), 1907, 2; and in Plotinos, *Opera*, ed., Dübner, Paris (Didot), 1855, p. xxxi.
[14] Senior Zadith, in Manget, ii, 214; Evola, 118; Jābir, in Kraus, (2), 124–5.
[15] Bidez, (4), 74; Dieterich, (2), 35, 42; Origen, *Contra Cels.*, vi, 22.
[16] *De antro nympharum*, cc. 5–6; in *Opuscula*, 1886.

IAMBLICHOS

Iamblichos, born not later than A.D. 280 at Chalkis in Coele-Syria, lived there until his death not later than 336. His teachers were Porphyry and Anatolios, and he founded his own school in Syria, perhaps at Apamea. He was a true Oriental.[1] He had the reputation of being a magician; Eunapios (A.D. 346–414) says that during his devotions Iamblichos was raised several feet into the air, a Buddhist feature.[2] Eunapios also says that Iamblichos produced Eros and Anteros from a spring in Gadara.

Iamblichos modified the doctrines of Plotinos more deeply than Porphyry, and 'always has a distinctive drift of his own'.[3] Modern opinion regards him not merely as a theologian and mystic (Zeller's view), but also as a systematiser and interpreter of Plato.[4] Above the One of Plotinos he put a higher First One (ἄρρητος ἀρχή), completely without properties or opposites.[5] There is a chain of causes governing events by fatality (εἱμαρμένη).[6] Iamblichos divided the 'emanations' of Plotinos into threes or sevens (Neopythagorean number mysticism).[7] The planets are visible gods (θεοὶ φανεροί),[8] and the universe a great animal (ἓν ζῶόν ἐστι τὸ πᾶν),[9] on which the planets send out influences of various natures acting on it by sympathy.[10] There are some Egyptian astrological ideas.[11]

Iamblichos wrote a semi-popular encyclopaedia of Pythagoreanism, including mathematics, music, and theological arithmetic.[12] His most celebrated work is commonly called 'On the Mysteries (*De Mysteriis*)',[13] in which Abammon, an Egyptian priest (Iamblichos ?) replies to Anebo (Porphyry ?).[14] The work was well known to the Arabs.[15] It is ascribed to Iamblichos in a note in the best MS. and is now thought to be his, composed about A.D. 300–4.

[1] Bigg, 302; Deussen, (1), II, i, 507; Kroll, PW, ix, 650; M au, *ib.*, 645; Nestle, (2), i, 152; i, 341; Otto, (1), 129; Schmidt, in Christ, 1913, II, ii, 858; Schm itz, DBM, ii, 549; Simon, (1), i, 177; ii, 187; Tennemann, vi, 207–84; Ueberweg, (1), i, 612–17; Vacherot, (1), ii, 57; Whittaker, (1), 121; Zeller, (1), III, ii⁴, 735.

[2] Eunapios, 362; Tylor, *Primitive Culture*, 1903, i, 149.

[3] Whittaker, (1), 123.

[4] Ueberweg, (1), i, 614.

[5] Deussen, (1), II, i, 507.

[6] Simon, (1), ii, 198 f., 212.

[7] Bigg, 305 f.; Vacherot, (1), ii, 60 f.

[8] Mau, PW, ix, 649.

[9] Parthey, (3), 164, 195.

[10] *Ib.*, 55, 164, 195; Bouché Leclercq, 313 f.; Reitzenstein, (2), 259, 270 f. (also in Papyrus Mimaut, 3 cent.).

[11] Riess, PW, ii, 1825.

[12] Deussen, (1), II, i, 507; Whittaker, (1), 123 f., 225; Zeller, (1), III, ii⁴, 717.

[13] (1), *Iamblichus De Mysteriis Aegyptiorum, Chaldaeorum, Assyriorum: Proclus in Platonicum Alcibiades de anima atque daemone, magia, etc. Porphyrius de divinis, atque daemonibus: Mercurius Trismegistus, Pimander: Mars. Ficinus, de triplici vita, de voluptata, de magia etc.*, Venice, 1497, 1516, etc.; (2) Greek text and Latin tr.: *Iamblichi Chalcidensis ex Coele-Syria, De Mysteriis Liber. Præmittitur Epistola Porphryrii ad Anebonem Ægypticum, eodem argumento*, ed. Thomas Gale, sm. f°, Oxford, 1678 (Porphyry's letter reconstructed, ff. *b2–d2*; contents; Greek text and Latin tr., pp. 1–179; notes, 181–316; iii ll. index and errata); (3) (2) reproduced by G. Parthey, Berlin, 1857; (4) tr. T. Taylor, *Iamblichus on the Mysteries of the Egyptians, Chaldeans and Assyrians*, Chiswick, 1821, repr. London, 1895; (5) tr. (from Parthey), Hopfner, *Über die Geheimlehren von Jamblichus*, Leipzig, 1922, with notes. The text in the MSS. has no title.

[14] W. Scott, *J. Egypt. Archaeol.*, 1922, viii, 114; 1923, ix, 243; *id.*, (1), iv, 40 f.; Zeller, (1), III, iii⁴, 774.

[15] Kraus, (2), 128.

Proklos quotes a passage as by Iamblichos.[1] The Egyptian sources are fictitious. Only an unknown MS. used by Gale adds περὶ τῶν Αἰγυπτίων μυστηρίων (the latter, according to Hopfner, meaning 'occult teachings' rather than 'mysteries'); the 'Chaldaeans and Assyrians' in Ficinus's title seem to be his own invention.

Porphyry had complained that the Egyptians spoke only of natural things and had not explained the incorporeal and living essences. Iamblichos answered that, on account of sympathy, various materials such as stones, plants, animals, incense, etc., in which spirits reside as pneumatic forces, are adapted to the worship of particular gods, and special words, particularly those in the original languages such as Egyptian and Chaldaean, which lose their power when translated, produce magic results. This idea is also in the so-called *Chaldaean Oracles* (Λόγια Χαλδαϊκά) attributed to Zoroaster, a forgery of *c*. A.D. 180–200, containing Pythagorean, Platonic, Stoic, Mithraic, and gnostic elements.[2] Iamblichos explains that the making of images (εἰδωλοποιία), like the arts of medicine and gymnastics (ἰατρική τε καὶ γυμναστική), participates in a certain measure in the creative power, thanks to an emanation from the divine world, and Porphyry does not deny this. The 'animated statues' appear in the Hermetic Books (p. 237). A new doctrine is that the soul must descend and ascend entire periodically; it has no permanent place in heaven; this is a gnostic idea.[3]

An attempt to revive pagan religion was made by the Emperor Julian 'the Apostate' (A.D. 331–363), who believed in oracles, divination, and astrology.[4] His friend Maximos of Ephesos, executed under the Emperor Valens in 371, had the reputation of being a magician; he made the image of Hekate smile and torches in her hands inflame.[5]

Proklos

The last important Neoplatonist was Proklos 'the Successor (ὁ Διάδοχος)', of Lydian extraction, born in Constantinople in A.D. 410 (or 412). He studied in Alexandria with Olympiodoros and in Athens with Syrianos, whom he succeeded in 450 as head of the school; he died in Athens in 485.[6] He

[1] T. Bergk, *Griechische Literaturgeschichte*, 1887, iv, 569; Festugière, (1), iii, 48, 174; Hopfner, (1), viii–xvi; *id.*, PW, II Reihe, vi, 258; Kroll, PW, ix, 650; Mau, *ib.*, 649; W. Scott, (1); iv, 40 f.; Simon, (1), ii, 219; Tennemann, vi, 279; Thorndike, (1), i, 307; Vacherot, (1), ii, 57, Weinreich, *A. Rel.*, 1925, xxiii, 123; Whittaker, (1), 134; Wiedemann, *A. Rel.*, 1922, xxi, 482.

[2] Text and tr. in Cory, (1), 239–80; and A. V. W. Jackson, (1), 259–73; Bidez, (2), i, 64, 158; Bouché Leclercq, 599; Bousset, *A. Rel.*, 1901, iv, 263; Cumont, (1), 202, 233; Dieterich, (2), 35, 205; Festugière, (1), iii, 52; Hopfner, (1), 195, 244; *id.*, *Beih. a. O.*, 1925, iv, 70; W. Kroll, *Breslauer philologische Abhandlungen*, 1894, vii, no. 1 (76 pp.); *id.*, *Rhein. Mus.*, 1895, l, 636; Ueberweg, (1), i, 523. They were much read by Neoplatonists; Proklos and Psellos wrote commentaries on them (Migne, PG, 1864, cxxii, 1115).

[3] Inge, ERE, ix, 317.

[4] Bidez, (4); Deussen, (1), II, i, 508; A. Rostagni, *Giuliano l'Apostata*, Turin, 1920; Whittaker, (1), 131; *Works*, ed. and tr. Wright, 3 vols. (Loeb), 1913–23.

[5] Eunapios, (1), 327, 427, 443; Theodoret, *Hist. Eccles.*, iii, 22; Burckhardt, (1), 227; Mozley, DCB, iii, 885; Praechter, PW, xix, 2563.

[6] Beutler, PW, xlv, 186–242; Bigg, 316; Marinus, *The Life of Proclus*, tr. T. Taylor, 4°, 1788; H. F. Müller, BPM, 1918, xx; J. L. Rosán, *The Philosophy of Proclus*, New York, 1949; Simon, (1), ii, 384; Tennemann, vi, 284–352; Ueberweg, (1), i, 625; Vacherot, (1), ii, 210; Whittaker, (1), 157, 229; Zeller, (1), III, ii[4], 834; Proklos, *Opera*, ed. with Latin tr., by V. Cousin, 6 vols., Paris, 1820–27; I have not seen his ed. of *Opera inedita*, Paris, 1864.

composed commentaries on Plato's works,[1] works on mathematics,[2] physics,[3] metaphysics,[4] and two works on theology: *On the Theology of Plato*[5] and *Elements of Theology* (*Στοιχείωσις θεολογική*).[6]

To Plotinos's laws of emanation and undiminished giving, Proklos added a hird, of continuity; there is no physical vacuum, and no spiritual, and the *qualitative* interval between any terms of the procession is the minimum compatible with distinctness.[7] The One produces a Second which in a sense remains in its cause and in another sense emerges from it. It 'turns back' to its cause and endeavours to reunite with it. The being of what is produced in what produces it (*μονή*), its emergence (*πρόοδος*), and its return (*ἐπιστροφή*), constitute three inseparable moments, the repetition of which develops all things from their origin.[8] Matter is neither good nor evil, but is the source of natural necessity. The triad, immanence in the cause, procession from the cause, and reversion to the cause, is usually[9] regarded as special to Proklos, but perhaps[10] originated with Iamblichos. The primordial One is a plurality of unities (*ἑνάδες*). The effects of higher causes reach further down the scale of being, emerge sooner in the generation (*γένεσις*) of an empirical individual, and survive longer in its corruption (*φθορά*). The word *πλήρωμα* (*pleroma*), borrowed by Iamblichos from gnosticism, is a favourite one with Proklos and means 'complete sum' or 'complete set'.[11]

According to Proklos, the soul is life and all that lives (*πᾶσα ψυχὴ καὶ ζωή ἐστι καὶ ζῶν*); after it comes nature (*φύσις*), which is penetrated and filled by soul and is the first sensible principle; this is Plato's idea rather than that of Aristotle, who confounded nature with form.[12] The science of nature is physiology (*φυσιολογιά*), dealing with the final cause, the paradigm, the demiurge, ideas, and the soul of the world.[13] Nature does not work on matter like a seal on wax, as the Stoics taught, but by internal development, and there are three types of participation: (1) impress (*τύπωσις*), (2) emanation (*ἔμφασις*), and (3) image (*ὁμοίωσις*). Matter, without property or power, is real, the basis for phenomena and the receptacle of forms; without it the nature of things would be inexplicable; it is not essentially evil but only with respect to the soul and intelligence. Each of the four elements exists particularly by itself, but all are in all; the individual elements differ in (*a*) tenuity of parts (*λεπτομερές*), (*b*) power to penetrate objects (*ὀξύ*), (*c*) mobility (*εὐκίνητον*), (*d*) bluntness (*ἀμβλύ*), (*e*) coarseness (*παχυμερές*), and (*f*)

1 *In Platonis Timaeum Commentaria*, ed. E. Diehl, 3 vols., Leipzig (Teubner), 1903–4–6; *In Platonis Rem Publicam Commentaria*, ed. W. Kroll, 2 vols., Leipzig (Teubner), 1899–1901; etc.

2 *The Philosophical and Mathematical Commentaries of Proclus on the First Book of Euclid's Elements*, tr. T. Taylor, 2 vols. 4°, 1792; etc.

3 *Instituto Physica* (*στοιχείωσις φυσική*), ed. with German tr. by A. Ritzenfeld, Leipzig (Teubner), 1912.

4 *Proclus, Metaphysical Elements*, tr. T. M. Johnson, Osceola, Mo., 1909.

5 *In Platonis Theologiam libri sex*, f°, Hamburg, 1618; *The Six Books of Proclus on the Theology of Plato ... to which a seventh Book is added ... also a translation of Proclus; Elements of Theology*, T. Taylor, 2 vols. 4°, 1816; *id.*, *Two Treatises of Proclus*, 1833.

6 *Proclus, The Elements of Theology*, ed. and tr. (with notes) by E. R. Dodds, Oxford, 1933.

7 Dodds, (1), 216.
8 Ueberweg, (1), i, 625.
9 E.g. Zeller, (1), III, ii⁴, 848.
10 Dodds, (1), 220–1.
11 Dodds, (1), 238, 292.
12 Vacherot, (1), ii, 302 f., 309, 344; Zeller, (1), III, ii⁴, 855.
13 Vacherot (1), ii, 313 f.

impermeability (δυσκίνητον): fire is $a+b+c$; air is $a+d+c$; water is $e+b+c$; earth is $e+d+f$.[1] Proklos invented the 'astral body'.

Dodds[2] says the name ἀστροειδές first occurs in Proklos, previous writers speaking of a 'luminous', 'ethereal', or 'pneumatic' body; it goes back to Plato and to Aristotle's *ether*; the Pauline 'spiritual body' (σῶμα πνευματικόν) had a different origin from the Greek ὄχημα-πνεῦμα, although Christian Platonists later identified them.[3] The fusion of the Platonic ὄχημα (vehicle) and Aristotelian πνεῦμα (see p. 193) occurs first in Galen. The 'envelope of the soul' is in the Hermetic Books. Porphyry says the ethereal πνεῦμα in descending to earth becomes dark and thick by absorbing moisture from the air, but it can lose this impurity in ascending; demons are composed of 'misty (ἀερῶδες)' πνεῦμα. Reinhardt[4] thought the theory of a luminous soul pneuma (πνεῦμα αὐγοειδές) originated with Poseidonios, who said the cosmos also has a luminous envelope; it is also mentioned by Origen and Julius Africanus. The ἀντίμιμον πνεῦμα of *Pistis Sophia* (see p. 253) is a similar idea.

Plotinos regarded the pneumatic body as incorporeal and immaterial, formed from ether, not fire,[5] as did Olympiodoros, who says it is not spherical like the star gods but egg-shaped.[6] Psellos (11 cent. A.D.)[7] said the pneumatic body could be hurt by knives, swords, and pins, and although invisible contained some earthy particles, remaining as ashes when it was burnt, 'as the Etruscans had found.'

The Neoplatonists believed in demons of the four elements; in space they are incorporeal energies, but they assume visible forms in association with matter. There were also demons of matter associated with animals, plants, stones, and minerals, which were ruled by special 'archons', and the whole of creation was ruled by the demons of matter.[8] The archangels and angels of Neoplatonism are derived from Jewish sources, modified by Babylonian and Iranian influences and related to the Babylonian planetary gods. The belief that every part of the human body is subject to a demon is based on the theory of sympathy and the microcosm. It is mentioned by Origen[9] as Egyptian; he gives the Egyptian names of some of the demons, which are in part found in Egyptian lists. It also appears in Jewish and in Neoplatonic authors such as Proklos.[10]

A work περὶ τῆς καθ' Ἕλληνας ἱερατρικῆς τεχνῆς of Proklos[11] says that everything is full of gods, and all things are connected by a divine chain of sympathy. The flower heliotrope (ἡλιοτρόπια) turns towards the sun and the selenotrope (σεληνοτρόπια) towards the moon: they offer prayers and sing hymns. The stone helite (ἡλίτη) with golden rays imitates the sun; the stone called 'eye of Bel', which throws light from its pupil, is the 'eye of the sun'; selenite changes its form and movement with the moon, and the helioselenon

[1] Vacherot, (1), ii, 340 f.
[2] The Astral Body in Neoplatonism, in (1), 313–21; Sarton, *Isis*, 1938, xxix, 423.
[3] F. J. F. Jackson and K. Lake, 1933, v, 96 f.
[4] (2), 380–1. [5] *Enneads*, II, ii, 2–3. [6] Hopfner, (1), 216 f.
[7] *De operatione daemonum*, ed. J. F. Boissonade, Nürnberg, 1838 (full of the crudest superstition); Hopfner, (1), 236; T. Taylor, *Iamblichus*, 1895, 220.
[8] Hopfner, (1), 201. [9] *Contra Cels.*, viii, 58.
[10] Blau, (1); Bouché Leclercq, 76; Burckhardt, (1), 221; Hopfner, (1), 202, 268 f.; Lobeck, (1), ii, 908–47 (macrocosm and microcosm); Tennemann, vi, 314.
[11] CMAG, vi, 148–51; *De sacrifiis et magia*, in *Iamblichus*, *De Mysteriis* . . . , ed. Ficinus, Venice, 1516, 35*v*; tr. T. Taylor, *Iamblichus*, 1821 (or 1895), 343 f.; and Festugière, (1), i, 134 f. The names occur in magic papyri and are perhaps from Iamblichos and ultimately of Egyptian origin; Dodds, (1), 276; Hopfner, PW, xiii, 767. Origen, *De principiis*, iii, 1; ANL, x, 158, said the Neoplatonists believed that metals as well as plants and animals have souls.

(ἡλιοσέληνον) is an image of the conjunction of the sun and moon. In heaven there are earthly plants, stones, and animals, with an intelligent life, and many earthly things have heavenly natures.

MACROBIUS

Macrobius (fl. *c.* A.D. 400), perhaps an African, wrote (1) a Neoplatonic commentary on Cicero's *Somnium Scipionis*, perhaps based on Porphyry, and (2) *Saturnalia*, possibly imitating Athenaios.[1] In a passage explaining the mysteries of Mithra[2] he says the soul (*anima*), passing from the divine world above the Moon through the gate of the zodiacal sign of Cancer, descends through the seven planetary spheres and assumes from them a luminous body (*luminosi corporis*) and the various faculties which make up the composite nature of man. In the ascent through the spheres, these attributes are put off one by one, and the purified soul passes through the gate of Capricorn to union with the supreme.

Asklepiodotos of Alexandria (fl. *c.* A.D. 450), who belonged to the school of Proklos, was interested in biology, medicine, and mathematics, and was less mystical than Proklos; all his works, including a commentary on Plato's *Timaios*, are lost.[3]

DAMASKIOS

Damaskios (*c.* A.D. 458–after 533), head of the Platonic Academy in Athens from about 520 till it was closed by Justinian in 529, wrote a work *On Doubts and Solutions Concerning the First Principles* (Ἀπορίαι καὶ λύσεις περὶ τῶν πρώτων ἀρχῶν)[4] containing fragments of lost works. He inserts two more Ones between the primary One and the intelligibles of Plotinos, although it is reported that he afterwards said that such stages are illusory.

Damaskios reports Plato as saying that 'even vegetables are animals, and stones, metals, the entire earth, and each of the other elements are not absolutely without soul',[5] but this is not found in any work of Plato's. Damaskios followed Plotinos in saying that stones have a power of growth and increase in volume 'of themselves'.[6] He followed Aristotle in saying that the four elements never exist in a state of purity (καθ' ἑαυτὰ), but each is always mixed with the others.[7] He quotes the 'contemporary Egyptian philosophers' Asklepiades and Heraïskos as saying that the unique principle of the universe is the great secret (μεγάλη κρύψις) or unknowable darkness (σκότος ἄγνωστον), and that there are two principles, water and sand (ὕδωρ καὶ ψάμμος) from which three gods called Kamephis are generated in succession and form the

[1] Text ed. F. Eyssenhardt, Leipzig (Teubner), 1893; Glover, (2), 171, 188; Whittaker, (2).
[2] *Somn. Scip.*, i, 12 f.; Whittaker, (2), 65.
[3] R. Asmus, *A. Med.*, 1913, vii, 26; Freudenthal, PW, ii, 1641; E. H. F. Meyer, ii, 307; Tennemann, vi, 354.
[4] Text, *Dubitationes et solutiones de primis principiis*, ed. C. E. Ruelle, 2 pts., Paris, 1889; tr. A. E. Chaignet, *Damascius le Diadoque, Problèmes et Solutions touchant les Premiers Principles* 3 vols., 1898; fragms. from Photios in Diogenes Laertios, ed. Cobet, Paris (Didot); Zeller, (1), III, ii[4], 901.
[5] Chaignet, i, 292.
[6] Chaignet, I, xxxiii; ii, 382 f.; iii, 66 f.
[7] *Ib.*, I, xxxvi, 311 f., 324 f.

universe (διακοσμος).[1] An anticipation of the quantum theory says 'motion progresses by jumps (κατὰ ἅλματα)'.[2] Damaskios wrote a life of his master Isidoros of Gaza,[3] a friend of Proklos and Marinos.

When Justinian closed the Academy at Athens in A.D. 529, Damaskios and six other teachers, Simplikios of Cilicia, Eulalaios of Phrygia, Priscianus of Lydia, Diogenes and Hermeias of Phoenicia, and Isidoros of Gaza (a very Oriental assembly) emigrated to Persia, where they were well received by Chosroës. They found conditions unfavourable and Chosroës arranged with Justinian in 533 that they should be allowed to return, though perhaps not to Athens. (Another account says Justinian did not close the school but suspended all salaries.)[4] The last members of the Academy at Athens were 'scholastic', uniting Platonic, Aristotelian, Stoic, Pythagorean, Orphic, and Eastern teachings.[5] The visit of the Greek philosophers to the court of Chosroës may have had some influence on the later mysticism of the Persian Ṣūfī.[6] Neoplatonic works had a great influence on Arabic philosophy, largely because they were mistaken for writings of Aristotle.[7] A *Theology* attributed to Aristotle and translated into Arabic is a Neoplatonic compilation made about A.D. 500, and used by al-Kindī, al-Fārābī, and Avicenna. It is a paraphrase of *Enneads* 4, 5 and 6 of Plotinos. From a Latin translation of it from Arabic, Neoplatonism entered early European Scholastic philosophy as Aristotle's teaching.[8]

A treatise *De Causis* attributed to Aristotle[9] is based on the *Elements of Theology* of Proklos. It is probably earlier than al-Fārābī (d. A.D. 950), to whom it has been ascribed. It was important in the transmission of Neoplatonism to Jews and Arabs, and thence, by Latin translations, to Europe.

Greek philosophy was now expiring. The name had lost its meaning: for late Latin authors *philosophus* meant, among other things, a foreman in a stone quarry.[10] The closing of the school at Athens was not the real cause of the decay of Greek philosophy.[11]

[1] Text, ed. Ruelle, 125 *quater*, pt. i, p. 324; tr. Chaignet, i, 152, 170, ii, 131 f.; see chap. I.

[2] *De Princip.* § 112; Inge, (1), 1929, ii, 243.

[3] R. Asmus, *Das Leben des Philosophen Isidoros von Damaskios, wiederhergestellt, übersetzt, und erklärt*, Leipzig, 1911.

[4] Agathias, ed. Niebuhr, Bonn, 1828, 130; Malalas, ed. Dindorf, Bonn, 1831, 451; Prokopios, ed. Dindorf, Bonn, 1838, iii, 459 (note); Kroll, PW, iv, 2039; Sprengel, (1), i, 192; Stahr, DBM, i, 932; Tennemann, vi, 352–76; Ueberweg, (1), i, 633.

[5] E. Chastel, *Histoire de la Destruction du Paganisme dans l'Empire d'Orient*, 1850; Deussen, (1), II, i, 507 f.

[6] E. G. Browne, (2) (*a*), i, 167; R. A. Nicholson, *Selected Poems from the Dīvāni Shamsi Tabrīz*, by Jalāl al-dīn Rūmi (1207–73), Cambridge, 1898, pp. xxv, xxx; Vacherot, (1), ii, 117, thought Ṣūfīsm drew on Indian rather than Neoplatonic sources.

[7] P. Duhem, *Système du Monde*, 1916, iv, 321–495.

[8] Dieterici, *Die sogenannte Theologie des Aristoteles aus dem Arabischen übersetzt*, Leipzig, 883; Deussen, (1), II, i, 481; Duhem, iv, 364–76; Vacherot, (1), iii, 86, 96.

[9] O. Bardenhewer, *Die pseudo-aristotelische Schrift über das reine Gute bekannt unter dem Namen Liber de Causis*, Freiburg i. Br., 1882 (330 pp.); Duhem, iv, 329–47; Vacherot, (1), iii, 86, 96.

[10] Blümner, iii, 81.

[11] Chwolsohn, i, 419; Vacherot, (1), ii, 400.

CHAPTER XII

THE HERMETIC BOOKS

The Hermetic Books (or *Hermetica*) consist of a collection of texts in Greek (one, the *Asclepius*, is known only in Latin), purporting to give the teachings of a god, Hermes Trismegistos. They were composed in Egypt and were supposed to contain Egyptian doctrines. From the time of the Church Fathers they attracted hardly deserved attention and were supposed to be older than they really are.[1] Zielinski[2] divided the texts into two groups: (i) popular, on astrology, magic, botany, medicine, occultism, and alchemy; and (ii) theological and philosophical, to which the name *Hermetic Books* is usually restricted. This division was criticised[3] but is probably correct. Nock[4] thinks the oldest parts are the astrological ones (first half of 2 cent. B.C.), which extend to the occult virtues of plants and stones. The philosophical literature was known to Philo of Byblos (2 cent. A.D.). The *Hermetic Books* contain little Egyptian material, but popular Greek philosophy (Platonic, Aristotelian, and Stoic), and traces of Jewish and Iranian influence, but no evident mark of Neoplatonism or Christianity. Hermetism is 'a precipitate formed by catalysis' rather than a new cult. The books were written in Egypt in A.D. 100–200, some perhaps about A.D. 250,[5] or as late as A.D. 300,[6] and for a clique of educated leisured persons, and not a definite 'church'.[7] They form no uniform 'Bible', parts are common property of the time, there are no particular ceremonies and no special prayers; they contain irreconcileable doctrines, and are 'a purely literary phenomenon'. Their main characteristics are the identification of science with religion, a belief that knowledge is imparted as revelation by a god (usually Hermes), the representation of the

[1] Berthelot, (1), 39; Creuzer, (1), i, 363; Diels, *Abhl. Akad. Berlin, phil.-hist. Kl.*, 1906, no. 1 (MSS); Dodd, (1), 99–209; (2), 1–53; Fabricius, (1) (*a*), i, 46; 1 (*b*), i, 46; Festugière, (1), (2); *id.*, *Kungl. Humanistika Vetenskapssamfundets i Lund Årsbererrätelse*, 1947–8, 1–58; Grässe, I, i, 266, 492, 497; C. F. G. Heinrici, *Die Hermes-Mystik und das Neue-Testament*, ed. E. von Dobschütz, Leipzig, 1918 (242 pp.; a good survey); Hoefer, (1), i, 249; A. G. Hoffmann, in Ersch-Gruber, 1829, Sect. I, Theil v, 323; Hopfner, *Beih. a. O.*, 1925, iv, 71; Kennedy, 104 f., 144; Kopp, (2), ii, 367; J. Kroll, (1); W. Kroll, PW, viii, 792–823; Lippmann, *Ambix*, 1938, ii, 21; (3), ii, 106; Marsham, 37, 231; Mead, (1); Ménard, (1); G. Van Moorsel, *The Mysteries of Hermes Trismegistus*, Utrecht, 1955; Mozley, DCB, ii, 926; Pietschmann, (1); Reitzenstein, (1)–(7); Sagnard, (1), 590 f.; Schmitz, DBM, ii, 411, 413; Scholl, ii, 615; W. Scott, (1); Schubart, (3), 95 f., 317 f.; Stock, ERE, vi, 626; Tennemann, vi, 471; Thorndike, (1), i, 287; ii, 214; Y. in NBG, xxiv, 377; Zeller, (1), III, ii[4], 242; Zielinski, *A. Rel.*, 1905, viii, 321; 1906, ix, 25.

[2] *A. Rel.*, 1906, ix, 57.

[3] Dieterich, *A. Rel.*, viii, 495.

[4] HT, I, i f.; (2);

[5] Albright, 280; W. Scott, (1), ii, 5–21, 60 f., 110; *Isis*, 1926, viii, 344.

[6] Dodd, (1), xv, 201 f.

[7] Schubart, (3), 95 f., 317 f.; Van Moorsel, 39, 129.

universe as a unity of concrete individuals linked by occult forces (including those from the stars) and conceived as living beings, and a reaction against abstract science. The physics is mostly Peripatetic and Stoic.[1]

Some of the works are long treatises, others are fragments known only in excerpts by Stobaios (5 cent. A.D.) and others. The *Asclepius*, the first work published (Rome, 1469), is a Latin translation of a Greek original; the Greek text of the prayer at the end is found in the magic Papyrus Mimaut (*c.* A.D. 300).[2] A Latin translation by Ficino of Hermetictexts was published at Treviso (near Venice) in 1471 as *Mercurii Trismegisti Liber de Potestate et Sapientia Dei*, and reprinted, with works of Iamblichos, etc. (see p. 231).[3] The Greek text of several treatises was first published under the title of the first by Turnebus.[4] Two new editions are:

(i) W. Scott, *Hermetica*, 4 vols., Oxford, 1924–36 (last vol. ed. by A. S. Ferguson) (text arbitrarily altered);[5] with English translation and notes.
(ii) *Corpvs Hermeticvm*, ed. A. D. Nock and A. J. Festugière, 4 vols., Paris, 1945–45–54–54, with French translation and notes (denoted by HT).

Various opinions have been held as to the origin and date of the *Hermetic Books*.[6] The early view was that they were composed in Egypt by Hermes about the time of Moses (16 cent. B.C.); Patrizzi and Lambeck[7] still believed this. Isaac Casaubon (Geneva, 1559–London, 1614) was apparently the first to say[8] that, although there may have been a man Hermes Trismegistos who lived before Moses, the *Hermetic Books* were written about the 1 cent. A.D., and their doctrine is not Egyptian but partly Greek (Platonic) and partly from the Bible. J. H. Ursinus[9] thought they were plagiarised from Christian works. About A.D. 150 there was probably an appreciable Christian element in Middle Egypt,[10] and Christian or gnostic influence has been claimed.[11] Tennemann supposed that the works formed a 'Bible of the heathens', in which dying paganism made its last stand against the development of Christianity, but there is little relation between the separate parts of the present Corpus, which was perhaps first put together by Michael Psellos

[1] Festugière, (1), i, 81 f.; iii, 24.
[2] L. Fahz, *A. Rel.*, 1912, xv, 409–21; Kennedy, 109, 162; HT, ii, 275, 352 f.; Reitzenstein, *A. Rel.*, 1904, vii, 393–411.
[3] Mead, (1), i, 8; W. Scott, (1), i, 31 f.; BN *Cat.*, 1920, lxxi, 126–37.
[4] *Mercurii Trismegisti Poemander, seu de potestate ac sapientia divina. Aesculapii Definitiones ad Ammonem Regem*, sm. 4°, Paris, 1554. Other eds.: ed. François Foix de Candalle (Franciscus Flussas), *Mercurii Trismegisti Pimandras*, Bordeaux, 1574; ed. Franciscus Patricius (Patritius, Patrizzi) in his *Nova de Universis Philosophia* . . . , f°, Ferrara, 1591, Venice, 1593; Latin tr., with immense collection of notes, by Hannibal Rossel, *Pymander*, 6 vols. f°, Cracow, 1585–90, Cologne, 1630; ed. G. Parthey, *Hermetis Trismegisti Poemander*, Berlin, 1854.
[5] Nock, *J. Egyptian Archaeol.*, 1927, xiii, 89; Tondelli, *Gnostici,*, Turin, 1950, 60 (confuse e tormentato da glosse).
[6] Mead, (1), i, 18–46.
[7] (1), 1781, vii, 62; *id.*, (2), 1712, 494.
[8] *De Rebvs Sacris et Ecclesiasticis Exercitationes XVI ad Cardinalis Baronii Prolegomena in Annales*, f°, London, 1614, Excrc. I, x, pp. 70–87; Scott, (1), i, 41–3 (dates it 1613).
[9] De Mercurio Trismegisto eiusque Scriptis, in his *De Zorcastro Bactriano Hermete Trismegisto, Sanchoniathone Phoenicio Eorumque Scriptis, & aliis contra Mosaicæ Scripturæ Antiquitatem*; *Exercitationes Familiares*, Nürnberg, 1661, 73–180.
[10] H. I. Bell, (4), 80–1.
[11] Beausobre, ii, 322, 445; Cudworth, i, 540–70; Kennedy, 104 f., 144; Tennemann, 1807, vi, 465 f., 470; Verbeke, 307–20.

(A.D. 1018–after 1078).[1] Jewish influence is likely,[2] Neoplatonic has been suggested[3] and denied.[4] They may have been influenced by Neopythagoreanism, but developed independently.[5] They were probably composed in Alexandria in Greek and not by Egyptian priests.[6] The description by Clement of Alexandria of '42 books of Hermes' which were possessed by Egyptian priests indicates a large Hermetic literature of Egyptian origin.[7] A *Definitions from Asklepios to King Ammon*[8] blames the Greeks for translating Egyptian books, since the truth can be conveyed only in the Egyptian language and the proper intonation of the words is necessary if these are to retain their power (τὴν ἐνέργειαν τῶν λεγομένων). Fragment XXIV, in which Isis explains the cosmology of the universe, may have an Egyptian original.[9] The *Hermetic Books* cannot be later than *c.* A.D. 300, when Arnobius attacked the teachings, which he probably knew from Cornelius Labeo (*c.* A.D. 250–300).[10]

The *Hermetic Books* mention a highest god (ὕψιστος θεός), more complete by being androgyne (ἀρρενόθηλυ) with the logos (λόγος) as an emanation (from Philo)[11]; this is a Pythagorean but particularly Stoic and Neoplatonic idea. Knowledge (γνῶσις) gives salvation. The doctrine of the fall of man, revealed in Hebrew scriptures under a veil of myth, must be clarified by philosophy.[12]

Reitzenstein[13] thought the point of departure was a doctrine of the priests of Ptah in Memphis (*c.* 700 B.C.), in which the god created by his voice.[14] In a Leyden magic papyrus (W, A.D. 346) a god laughs seven times, each time producing a god, the third being Nous or Hermes.[15] In ancient Egypt *mā khrū* denoted the correct enunciation of a magic spell and the speech of the god Thoth, whose 'words' created things; it later became associated with the Greek *logos*.[16] Parts of the Hermetic book *Poimandres* resemble the Egyptian Demotic Papyrus Insinger (1 cent. A.D.).[17] Petrie, and Eisler[18] thought the basis

[1] Festugière, (1), i, 82; ii, 1 f.; iii, 34; Kroll, PW, viii, 804; Reitzenstein, (2), 211 f., 319; W. Scott, (1), i, 29.

[2] Dodd, (1), 99, 106, 121, 154, 209, 219, 235, 243–5; Festugière, (2), ii, 10 f., 217; Ménard, xi, xliv f., lxxiv, lxxxix, xcv, 41 (Indian parallels), 47, 196, 277; E. Meyer, (2), ii, 371 f., 375; Reitzenstein, (2), 328–60; (7), 154 f. (revised text); W. Scott, (1), ii, 5–15, 60 f.; *Isis*, 1926, viii, 344; Weinreich, *A. Rel.*, 1925, xxiii, 121 (very little).

[3] Albright, 280; L. F. O. Baumgarten-Crusius, *De Librorum Hermeticorum origine atque indole*, Jena, 1827 (19 pp.); Dieterich, (1), 2, 31, 86, 134; W. Kroll, PW, viii, 794; Windelband, (1), 216.

[4] Nock, in HT, I, i f.; Zeller, (1), III, ii[4], 242–54.

[5] Festugière, (1), i, 355 f.; J. Kroll, (1), 294 f., 305–8; W. Kroll, PW, viii, 815; Zeller, (1), III, ii[4], 242–54; Zielinski, *A. Rel.*, 1905, viii, 340; 1906, ix, 25 f.

[6] Dieterich, (1), 162; Festugière, (1), i, 86 f.; J. Kroll, (1), 55, 79; W. Kroll, PW, viii, 801, 815 f.; Nock, HT, I, i f.; Otto, (2), iii, 215 f.; Soltau, 147 f.

[7] Berthelot, (1), 40 f., 133; Ruska, (3), 10 f., 36 f.

[8] HT, ii, 228 f.

[9] HT, iv, 51 f.; Festugière, (1), i, 324.

[10] Baehrens, MGM, 1920, xix, 155; Puech, *Les Apologistes Grecs du II[e] Siècle de notre ère*, 1912, 178, 197; Waszink, 47*.

[11] J. Kroll, (1), 1, 52, 57.

[12] Dodds, (1), 157, 245; Festugière, (1), i, 355–62.

[13] (1), 83–93, 108–11; (2), 59, 114, 146, 211 f.; (5), 33, 40, 52, 174; (6), 65 f., 74 f., 82, 92; *Festschrift für F. C. Andreas*, Leipzig, 1916, 33; *A. Rel.*, 1930, xxviii, 67.

[14] Deubner, Ro., iii, 2091 (Orphic); Erman, (1), 92; Hopfner, *Beih. a. O.*, 1924, iv, 33; Maspero, *The Dawn of Civilisation*, 1894, 147 f.; Mead, (1), i, 130; perhaps proto-dynastic: Albright, 132.

[15] Dieterich, (1), 3–20, 62 f., 70 f., 195; Festugière, (1), i, 300 f.; PMG, ii, 95.

[16] Dornseiff, 118 f.; Leisegang, PW, xiii, 1068.

[17] Erman, (1), 344, 454.

[18] (1), 503 f.; (3), 314; Scott, (1), 1, 45.

went back to Egypt in the Persian period (*c.* 450 B.C.). The oldest fragments may be in the *Strasbourg Cosmogony*, in which Hermes formed the heavens in seven zones ruled by archons which related to the seven garments (στολαὶ ποικίλαι) of Isis mentioned by Plutarch[1] and the Naassenes (1–2 cent. A.D.);[2] Poimandres was created.

Reitzenstein[3] thought the original of *Poimandres* goes back to the end of the I cent. B.C., when a new god, Poimandres (*Ποιμάνδρης*) appeared. The name has been derived from the Egyptian or Coptic *P-eime-n-rē* ('knowledge of the sun god Rē'),[4] or from ποιμήν (shepherd), *Ποιμανδρος* meaning 'shepherd of men'[5] and Anthropos in the *Hermetic Books* is Iranian.[6] Iranian influence, assumed by Reitzenstein, and Bousset,[7] is disputed.[8] Although, as Reitzenstein said, the name *Ποιμένανδρα* is given by the alchemist Zosimos (A.D. 250–300) to the author of the Hermetic *Κρατήρ* another MS. reading is *Ποιμάνδρα*.[9]

The Greek god Hermes was well-known to Homer. He had a great number of attributes.[10] The staff or wand (κηρύκειον or κηρύκιον, Lat. *caduceus*) carried by Hermes was perhaps originally a fetich representing the mandrake root; the serpent staff also appears on a Sumerian vase of *c.* 2000 B.C. representing the healing god Ningishida, the prototype of Asklepios. Another different staff (Lat. *lituus*, perhaps Etruscan) was an augur's wand.[11]

The ancient Egyptian god Thoth (ḏḥwtj, formerly read Tehuti) was originally a local god of the Delta who migrated to Shmun or Chnumu (now Achmūnein) in Middle Egypt (the Greek Hermopolis Magna), with the cynocephalis and ibis as sacred animals; he identified with the Moon (Ioh). He became the scribe of Osiris and is shown recording the weight of the heart of the deceased in the scene of the judgment hall. As the inventor of writing he became the originator of all arts, sciences, and magic. He knew how to pronounce the magic spells with the correct intonation. He was 'the secretary of the gods', represented with the head of an ibis.[12] Sanchuniaton called him

1 *Isis and Osiris*, 78; ed. Parthey, 1850, 138, 275.

2 Hippolytos, *Refut.*, v, 7; (1), 142; Reitzenstein, (1); (4), 65; Zielinsky, *A. Rel.*, 1906, ix, 30, 55.

3 (5), 9 f., 159.

4 Dodd, (1), 107; (2), 30, 121, 128; Festugière, (1), i, 80 f.; iii, 24; W. Scott, (1), ii, 5–21, 60 f., 110; *Isis*, 1926, viii, 344.

5 Proposed by Ménard, (1), xlv f.

6 Bultmann, *A. Rel.*, 1926, xxiv, 10; Reitzenstein, (7), vii, 9 f., 18, 20, 139; (8), 129 f.; Schaeder, in *ib.*, (7), 205 f.; *id.*, ZDMG, 1925, lxxix, 192 (201 f., 211).

7 (1), 160 f., 194 f., 202 f., 216 f.; Indian, *ib.*, 210, and Garbe, (1), 96.

8 Dodd, (1), 107; (2), 30, 121, 128; Festugière, (1), i, 80; Mead, (1), i, 369; E. Meyer, (2), iii, 618; W. Scott, *op. cit.*; Wessely, in Graffin and Nau, iv, 95; Zielinski, *A. Rel.*, 1905, viii, 323.

9 Berthelot, (2), ii, 245; HT, I, xxxviii, 49.

10 Eitrem, PW, viii, 738–92; E. Meyer, (1), ii, (1893), 97 f., 108; Scherer, Ro., i, 2358–2432; Schmitz, DBM, ii, 411; Soltau, 151.

11 Boetzkes, PW, xi, 334; Cook, ii, 383; Eisler, (1), 434, 581; Garstang, *Land of the Hittites*, 1910, 166; Haug, Ro., vi, 309; *id.*, PW, Suppl. i, 1920; Latte, PW, xiii, 805; *id.*, PW, Suppl. iii, 2300; E. Meyer, (1), 97, 108; Prinz, PW, viii, 1908; Scherer, Ro., i, 2358, 2427; Steuding, Ro., ii, 2205, 2806; F. M. de Waele, *The Magic Staff or Rod in Graeco-Italian Antiquity*, Gent, 1927.

12 Bonnet, 805; P. Boylan, *Thoth the Hermes of Egypt*, Oxford, 1922; Budge, (1), ii, 400; Creuzer, (1), i, 363; Drexler, Ro., ii, 1761; Erman, (1), 39; Festugière, (1), i, 67 f.; W. Kroll, PW, viii, 801; Parthey, (2), 154; Pietschmann, (1); Pietschmann and Roeder, Ro., v, 825–63; Preisendanz, *ib.*, 1140–45; Reitzenstein, (2), 18, 59 f.; Rusch, PW, II Reihe, vi, 351–88; M. Uhlemann, *Thoth, oder die Weisheit der alten Aegypter*, Göttingen, 1855.

the secretary of Kronos.[1] The identification of Thoth with Hermes was known to Herodotos (*c.* 450 B.C.),[2] Aristoxenes of Tarentum (*c.* 300 B.C.) and Hekataios (*c.* 300 B.C.), and was well known from 200 B.C.[3] The Greek name for Thoth, θεύθ, is given by Plato;[4] θυτ, θώθ, θαύθ, ταθ, and τατ are later; the Coptic name is θοουτ, which in the Fayyūm dialect is θατ.[5] In the Egyptian Pyramid Texts (*c.* 1790 B.C.) Thoth is guide of souls,[6] and the Greek Hermes Psychopompos (ψυχοπομπός) led souls into the shades;[7] he was identified with the Persian Mithras, who led souls to heaven.[8] For the Stoics he resided in the underworld as Hermes Chthonios (χθόνιος).[9] In the Hellenistic period Thoth-Hermes was identified with the Logos, controller of pneumata and guide of souls.[10]

The Egyptian Thoth resembled the old Sumerian god Enki, Babylonian Ea, who invented all arts and sciences, including magic, and presided over the 'deep', i.e. all waters.[11]

Zielinski[12] thought a knowledge of the Greek Hermes reached Egypt through Arkadia and Kyrene. In Boeotia Hermes was worshipped as Kadmos, Kasmos (related to *kosmos*), or Kadmillos. He presented his spouse Harmonia (related to the harmony of the spheres) with an unlucky gold necklace; the golden ram presented by Hermes to Atreus, and the golden fleece, belonged to the same group of legends, perhaps the origin of 'lower Hermetism' in Egypt.

The name Trismegistos (τρισμέγιστος), derived from the Greek superlative μέγιστος, means 'thrice greatest'. The Greek part of the trilingual inscription on the Rosetta stone, in honour of Ptolemy Epiphanes (196 B.C.), has Ἑρμῆς ὁ μέγας καὶ μέγας, 'Hermes the twice great',[13] and a hieroglyphic inscription in the temple of Denderah (1 cent. A.D.) speaks of 'Thoth the twice great'.[14] In magic papyri Hermes-Thoth is 8 ($=2\times2\times2$) times great.[15] It is suggested[16] that the Egyptian determinative *ur* (or *wr*) strengthened 'great great' into the equivalent of 'great great great'. The Egyptian superlative is a repetition of the positive; *āa* = great, *āa āa* = greatest, corresponding with μέγας μέγας or μέγας καὶ μέγας, both known in inscriptions. In the time of Ptolemy IV (221–205 B.C.) the Egyptian superlative was translated, practically only with reference to Hermes, by μέγιστος καὶ μέγιστος καὶ μέγιστος, and to spare repetition this became τρισμέγιστος.[17] The name Trismegistos occurs on a statue of A.D. 238–44, in a papyrus from Hermopolis of A.D. 260, once in the Paris Magic Papyrus and in a London Magic Papyrus (Ἑρμῆς τρισμεγας).[18] It does not occur in the many prayers to Hermes in the 3 cent. A.D. nor in Coptic gnostic works.[19]

[1] Cory, (2), 11. [2] ii, 137–8.
[3] Festugière, (1), i, 70; Pietschmann, (1), 12–25; Reitzenstein, (2), 117 f.
[4] *Philebos*, 18B; *Phaidros*, 274C–E. Plato does not identify Thoth with Hermes.
[5] Boylan, 4; Pietschmann, (1), 31; *id.*, Ro., v, 825.
[6] Boylan, 49, 141.
[7] Drexler, Ro., ii, 1176; Drexler and Scherer, *ib.*, i, 2342–2432; Höfer, *ib.*, iii, 3256.
[8] Dieterich, (1), 20, 62, 64, 70–1, 90, 195; Hopfner, (1), 265. [9] Heinze, 143.
[10] Budge, (1), i, 408; Dieterich, (1), 64; Mead, (1), i, 84; Reitzenstein, (2), 42.
[11] Jeremias, Ro., iii, 577 f.; Meissner, ii, 12, 54, 64 f., 111, 140, 207 f., 324.
[12] *A. Rel.*, 1905, viii, 371; 1906, ix, 41, 50, 57.
[13] Letronne, *Inscription Grec de Rosette*, 1841, 3, 20; FHG, ii, 512.
[14] Festugière, (1), i, 69. [15] F. Ll. Griffith, (1), 58.
[16] Pietschmann, (1), 35; cf. Brugsch, (1), 49, 124, 446; Parthey, (2), 155.
[17] Festugière, (1), i, 73; Kroll, PW, viii, 792–823; Preisendanz, Ro., v, 1140–45.
[18] Kenyon, i, 101. [19] Preisendanz, Ro., v, 1140–45.

In Egyptian stories the Books of Thoth are kept in chests in his tomb, and these chests had magical properties.[1] Clement of Alexandria (A.D. 150–215) says[2] the Egyptian priests carried in processions 42 books of Hermes (on papyrus), on laws, the gods, the education of priests, forms of worship, history, geography, hieroglyphics, astrology and astronomy, religious compositions, and six books on medicine. Iamblichos[3] (A.D. 250–325) says Hermes wrote 20,000 books according to Seleukos, or 36,525 according to Manetho. The books, written in hieroglyphics, were found in the adytum of a temple in Saïs, and were explained to King Ammon by Bitys the prophet (*Βίτυς προφήτης*). Iamblichos in mentioning Hermes[4] does not call him 'Trismegistos'; he says 'our ancestors . . . inscribed all their own writings with the name of Hermes'.

A spurious fragment of Manetho[5] says Thoth the first Hermes wrote (in hieroglyphics) on stela which he set up in the Seriadic land (Egypt). After the Flood they were translated into Greek and deposited in books in Egyptian temples by Agathodaimon, son of the second Hermes, the father of Tat (a duplication of Thoth).[6]

Classical and Patristic authors mention Hermes Trismegistos from the I cent. B.C.[7] Diodoros Siculus[8] says Hermes was an ancient Egyptian king. Cicero (106–43 B.C.)[9] has five Hermes, including Thoth (Thoyth). Philo of Byblos (A.D. 64–161) said the Egyptian Thouth (*Θόυθ*) was the same as the Phoenician Taaut (*Τάαυτος*), the Alexandrian Thoth (*Θωθ*), and the Greek Hermes (*Ἑρμῆς*).[10] Plutarch (*c.* A.D. 46–120)[11] knew of 'so-called books of Hermes (*ταῖς Ἑρμοῦ λεγομέναις βίβλοι*)'. Martial (*c.* A.D. 40–104)[12] mentions 'Hermes, omnia solus et ter unus',[13] Galen (A.D. 129–199)[14] knew of medical works by 'the Egyptian Hermes'. Athenagoras[15] cites Hermes Trismegistosos. Clement of Alexandria (A.D. 150–215), who mentions his 42 books (see p. 239), thought[16] Hermes was a man living in Thebes in Egypt, later deified (perhaps this might be a reminiscence of Imhotep.[17] A mention attributed to Justin Martyr (d. *c.* A.D. 165) is in a spurious work.[18]

Tertullian (A.D. 155/60–225) calls Hermes Trismegistos the master of all natural scientists 'magister omnium physicorum recognavit',[19] and says the Egyptian Mercury taught that the soul when separated from the body remains distinct and does not pass back into the universal soul.[20] Hippolytos (*c.* A.D.

[1] Maspero, (1), 31, 101, 141; Reitzenstein, (2), 18.
[2] *Strom.*, vi, 4; ANL, xii, 323; Berthelot, (1), 40; Budge, (1), i, 415; Mead, (1), iii, 222.
[3] *De Myst.*, viii, 1–3, 5.
[4] *De Myst.*, i, 1, 4; viii, 1–6; ix, 7.
[5] Synkellos, *Chronographia*, (1), 40; (2), i, 72; Cory, (2), 109; Mead, (1), i, 104, 108.
[6] Hopfner, *Beih. a. O.*, 1925, iv, 71; Jablonski, iii, 182, 188; Josephus, *Antiq.*, I, ii, 3; J. Marsham, 231; Reitzenstein, (2), 183 (*Σείρος* = Nile); Roeder, Ro., iv, 862.
[7] Fabricius, (1) (*a*), i, 46 f.; Festugière, (1), i, 74 f.; HT, I, xxxvii f.; iv, 104 f.; Jablonski, iii, 156 f., 164 f.; Mead, (1), iii, 215 f.
[8] i, 13, 16, 43; Reitzenstein, (2), 175.
[9] *De Nat. Deor.*, iii, 22.
[10] Marsham, 37; Cory, (2), 21.
[11] *Isis and Osiris*, 61.
[12] *Epigr.*, v, 24; Postgate, (1), ii, 463.
[13] Kroll, PW, viii, 793; Preisendanz, Ro., v, 1142.
[14] Kühn, xi, 798.
[15] *Supplicatio*, c. 28; Festugière, (1), ii, 48.
[16] *Strom.*, i, 21; ANL, iv, 438.
[17] Hurry, (1); Jablonski, iii, 192, 196; Reitzenstein, (2), 120.
[18] Mead, (1), iii, 215.
[19] *Adversus Valentinianos*, xv; Migne, PL, 1844, ii, 567 (written 207–10, Sudhoff, *A. Nat.*, i, 470).
[20] *De anima*, cc. 2, 33; ed. Waszink, 47, 395; Festugière, (1), i, 78 (A.D. 208–13); ii, 48; iii, 1.

175-236) mentions Hermes several times.[1] He and St. Cyprian of Carthage (*c*. A.D. 200-58)[2] associate him with Ostanes (see p. 280). The Coptic gnostic *Second Book of Jehu* (*c*. A.D. 250) refers to Hermes as thrice pneumatic (τρισπνεύματοι) or thrice potent (τρισδυνάμεις)[3] and in another old gnostic work he is *n*-potent (παντοδυνάμεις).[4] In the ψ-Clementine *Homilies* (*c*. A.D. 250)[5] Hermes is τρισεπάπειρος (*ter protendens*). The alchemist Zosimos (*c*. A.D. 250–300) had read the *Poimandres* and the discourse of Hermes to Tat on the Cup or the Monad (ὁ κρατὴρ ἤ Μονάς).[6]

Lactantius in his *Divinae Institutiones* (A.D. 304–13) and its *Epitome* (after A.D. 314)[7] quotes the *Hermetic Books* and names Hermes Trismegistos several times, also calling him 'Termaximus' and 'Thoyth':[8] Hermes Trismegistos was not only older than Plato but older than Pythagoras and the Seven Sages, and of the same opinion as them.[9]

Arnobius (*c*. A.D. 304–10) says the three philosophical schools, the Hermetic, Platonic-Pythagorean, and modern agree in their ideas.[10] St. Augustine (A.D. 354–430)[11] quotes the *Asclepius* and says that Hermes is λόγος (*sermo*) and the messenger (*nuntius*).[12] St. Cyril of Alexandria (d. A.D. 444) said the books of Hermes Trismegistos (τρισμέγιστος) were based on the writings of Moses, Pythagoras, and Plato.[13] The anonymous Christian Alchemist (6 cent. A.D.) says Hermes was called Trismegistos 'because of the three powers of the work (κατὰ τρεῖς τινας τῆς δυνάμεως ἐνεργείας)';[14] Damaskios (*c*. A.D. 520)[15] states that the Egyptians named the unknown One 'unfathomable darkness (σκότος ἄγνωστον)' and invoked it by repeating this name three times. For Souidas (*c*. A.D. 1000)[16] Hermes was called Trismegistos because he spoke of the Trinity, recognising in it one divinity.

In the Middle Ages, Hermes Trismegistos was often cited as an authority. Abailard (1079–1142), Thierry of Chartres (d. 1175), Alain of Lille (1128–1202), a *Liber XXIV Philosophorum qui dicitur Termegisti Philosophi* probably composed about 1200),[17] Daniel of Morley (*c*. 1175),[18] Vincent of Beauvais (*c*. 1250 ?),[19] William of Auvergne (d. 1249), Albertus Magnus (1193–1280),[20] Roger Bacon[21] and Thomas Bradwardine (1290–1349)[22] all name

[1] *Refut.*, iv, 48; v, 7, 14; (1), 118, 144, 146, 152, 186 (Ἑρμῆς τρισμέγιστος).
[2] *De idolorum vanitate*, vi; ANL, viii, 447.
[3] C. Schmidt, (1), 318.
[4] *Ib.*, 14, 24, 318, 339, 344, 354; he is not called Trismegistos.
[5] *Homiliae*, ed. Dressel, Göttingen, 1853, 341.
[6] Berthelot, (2), ii, 229.10, 245.6; Festugière, (1), ii, 28; HT, I, xxxviii, xlvii; W. Kroll, PW, viii, 794; Reitzenstein, (2), 102; *id.*, (7), 10; W. Scott, (1), i, 29; ii, 148; iv, 104.
[7] Lietzmann, PW, xii, 351; Migne, PL, vi, 823, 1017.
[8] *Div. Inst.*, i, 6, 7, 10; ii, 14; iv, 6, 7, 9; vi, 25; *Div. Inst. Epit.*, iv.; Migne, PL, vi, 138 (and note), 328, 461, 463, 469, 730, 1022; HT, iv, 105 f.
[9] *De Ira Dei*, xi; Migne, PL, vii, 112.
[10] *Adversus Nationes*, ii, 13; ed. Marchesi, Turin, 1934, 80.
[11] *Civ. Dei*, viii, 23, 24 (written *c*. A.D. 413–26); *Opera*, Paris, 1838, vii, 339; Mead, (1), iii, 249.
[12] *Civ. Dei*, vii, 14; *Opera*, 1838, vii, 280; from Varro; Preisendanz, Ro., v, 1144.
[13] Cyril, *Contra Julianum*, in Julian, *Opera*, ed. Ezekiel Spanheim, f°, Leipzig, 1696, bk. i, p. 30 (sep. pagin.); HT, iv, 125 f.
[14] Berthelot, (2), ii, 424. 9–10; Hoefer, (1), i, 255.
[15] (1), i, 152, 170; ii, 131.
[16] (2), i, 527.
[17] C. Baeumker, *Festgabe Georg Freiherr von Hertling*, Freiburg i.B., 1913, 17–40 (22, 28).
[18] Thorndike, (1), ii, 219.
[19] HT, ii, 270.
[20] *De Animalibus*, xxii, 9; HT, ii, 271 f.; Thorndike, (1), ii, 220.
[21] *Opus Minus*, ed. Brewer, 1859, 313: 'father of philosophers' (alchemists).
[22] Baeumker, 1913, 22.

or quote Hermes Trismegistos, also called 'Toc or Toz (=Thoth) Graecus'.[1] A design in the pavement of Siena cathedral, attributed to Giovanni di Maestro Stefano (A.D. 1488), shows Hermes Trismegistos in a pointed hat handing to a man in a turban a book on which is written: 'Suscipite o licteras et leges Egiptii (take up letters and laws, O Egyptians)'.[2] The chemical works attributed to Hermes are considered later.

The physics in the *Hermetic Books* is unoriginal and essentially Stoic. The elements are modifications of a common substance (ὕλη or οὐσία) and are interconvertible. The fifth element is πνεῦμα.[3] Energy (ενέργεια) is incorporeal but acts only in and through bodies. It is indestructible and several kinds are present in a body.[4]

The *Poimandres*[5] describes the ascent of the soul through the seven planetary spheres, in each of which it puts off an affection (presumably taken up in the descent to the earth). The Orphic doctrine that the soul can pass into animals is denied.[6] The most interesting work from our point of view is the *Κόρη Κόσμου*, probably composed from several sources. It has been much discussed.[7] It was written in Egypt in the 3–4 cent. A.D., perhaps using pre-Christian gnostic material.[8] Bousset thought the foundation was Egyptian revised in the light of Plato's *Timaios*. The meaning of the title, *Κόρη Κόσμου* may be 'virgin of the world' or 'pupil (as of the eye) of the world'. Plutarch[9] says Egypt is 'the black earth, as dark as the pupil of the eye' (τὸ μέλαν τοῦ ὀφθαλμοῦ χημίαν λαλοῦσιν). The old hieroglyphic name for Egypt is Kemi, Qem, or Qemt,[10] in the dialect of Lower Egypt, Qēmi (χημι), in Coptic, Qēme, 'the land of the black soil' as distinguished from the red land of the desert.[11] In an old inscription Egypt is the 'eye of Osiris' whose pupil is the River (Nile); the eyebrows are the hills of the East and West, and the contents of the eye are the temples of Upper and Lower Egypt.[12] Horapollo[13] said that 'Egypt is situated in the centre of the circle of the earth (οἰκουμένη) like the pupil (κόρη) in the eye'. The fertile black soil of the Delta was an attribute of Isis.[14]

[1] Thorndike, (1), ii, 220 f.
[2] Bucher, i, 134; W. Scott, (1), i, 32.
[3] J. Kroll, (1), 52, 57, 120–5, 134–7, 179–85; Ménard, (1), l, 115; Zeller, (1), III, ii[4], 242–54.
[4] J. Kroll, (1), 200 f.; Ménard, (1), 67; Zeller, (1), III, ii[4], 246.
[5] *Poim.*, i, 25; Dodd, (1), 154, 192 f.; HT, i, 15; Ménard, (1), lii f., 96 f.; Reitzenstein, (2), 336; W. Scott, (1), i, 128; Bousset, (1), 364; PW, vii, 1520; Zielinski, *A. Rel.*, 1905, viii, 332.
[6] *Poim.*, x, 19; HT, i, 123; Ménard, (1), 66.
[7] See the long essay, with bibliography, by Festugière, in HT, III, cxxvi–ccxix ('pénétrée de gnose'). Text and tr., HT, iv, 1–50; tr. Mead, (1), iii, 93; Ménard, (1), 177–221. See Bousset, PW, xi, 1386–91; Festugière, *Rev. Bibl.*, 1939, xlviii, 45; Hopfner, *Beih. a. O.*, 1925, vi, 71; J. Kroll, (1), 144; Mozley, DCB, ii, 926; Reitzenstein, (2), 136 f., 146, 191, 365; *id.*, (6), 70 f.; W. Scott, (1), i, 456–95; iii, 471; iv, 448 (Ferguson); Weinreich, *A. Rel.*, 1918, xix, 158 (166); Zielinski, *A. Rel.*, 1905, viii, 321 (356–68).
[8] Norden, (1), 65 f.
[9] *On Isis and Osiris*, 34.
[10] Partington, (1), 5, 530.
[11] Sethe, PW, iii, 2233.
[12] Pietschmann, PW, i, 985; Sethe, PW, iii, 2404.
[13] *Hieroglyphika*, i, 21; ed. Cory, 1840, 44 (ed. C. Leemans, Amsterdam, 1835; ed. and tr. A. T. Cory, London, 1840; ed. with commentary, Sbordone, Naples, 1940). The work was written in Coptic (the Copts had some knowledge of hieroglyphics as late as the 6 cent.: Bidez, (1), 233 f., 248) in the 4–5 cent. A.D. by Hōrapollōn Nilous (perhaps a professor in Alexandria) and translated into Greek by a Philip a century or two later; Bell, (3), 148; Festugière, (1), i, 326; Roeder, PW, viii, 2313; Schmitz, DBM, ii, 512; Thorndike, (1), i, 331; Wellmann, (5), 14; (6), 61 f.
[14] Reitzenstein, (2), 140, 145.

Zosimos (A.D. 250–300) compares the black (μέλαν) with the pupil of the eye (κόρη τοῦ ὀφθαλμοῦ).[1]

In the *Korē Kosmou*[2] Isis tells Horus that the movement of the heavenly bodies, by mysterious sympathy and secret effluvia, communicated fecundity and harmony to nature. The creator, to end fear, communicated part of his wisdom, not to the human race (which did not yet exist) but to the soul, which is Hermes, who engraved his thoughts on stone and hid the books in the tomb of Osiris, where Isis later found them. His successors were his son Tat (=Thoth), then Asklepios-Imuthes, Ptah-Hephaistos, and all those who love divine study. The supreme being took enough of his intelligence (νοῦς) for a breath (πνεῦμα), and mixed it with fire and other unknown substances (ὕλαις ἐκέρασε). Then, having united the elements, he pronounced certain secret incantations (ἐπιφωνήσεων κρυπτῶν) and stirred the mixture until it boiled, and a purer, more subtle, and more transparent, substance rose to its surface, visible only to the eye of its creator. This was called Animation (Ψύχωσις), and from it the creator made myriads of souls arranged in sixteen layers, working according to number and measure (εὐτάκτως καὶ συμμέτρως).[3]

The creator took a mixture of water and earth, and pronounced over it secret formulae; after agitating it and enduing it with *pneuma* by breathing into it, the creator took the crust (ἐπίπαγος) which formed on its surface and had become of a good colour (εὐβαφῆ, an alchemical term) and well coagulated (εὐπαγῆ), and made from it the signs of the Zodiac. Hermes made the body from earth and water and the soul from divine *pneuma* and intellectual fire (πῦρ νοερὸν); the mixture (κρᾶμα) of these separates on death by dialysis (διάλυσις). From the rest of the mixture (the composition of which Hermes kept secret) souls were invited to form something corresponding with their natures, and from its successive layers they made birds, quadrupeds, and reptiles.

When the *Korē Kosmou* was composed alchemy was known in Egypt and the process described may be chemical.[4]

The elements are personified;[5] this, and the relation of the soul to the body and the reminiscences of Mithraism, may be of Iranian origin. There are strong magical and popular astrological components.[6]

Hermetic Astrology

Some of the oldest (3 or 2 cent. B.C.) works attributed to Hermes Trismegistos are on astrology and its relation to medicine, Iatromathematics (ἰατρός, a physician; μαθηματικός, an astrologer), which originated in Egypt and was associated with Hermes-Thoth.[7] This aspect of Hermetism is not of interest

[1] Berthelot, (2), ii, 92.6.
[2] HT, iv, 4 f.; see also fragm. xxxiii, *ib.*, 140.
[3] The creation by 'voice', i.e. emanation, is Egyptian, the rest is based on Plato's *Timaios*; Dieterich, (1), 3–20. Pagel, *Ambix*, 1960, viii, 125 (140), thought the 'foam' rising to the surface was the spermatic fluid, a fiery water comparable with the alchemical 'sophic mercury' for the animation of metals.
[4] Festugière, (1), i, 88 (operation alchimique); *id.*, *Revue Biblique*, 1939, xlviii, 45 (52) (c'est l'alchimie); *id.*, *Pisciculi*, 1939, 102–16 (alchemical); Ménard, (1), lxxxvii (operation chimique); Zielinski, *A. Rel.*, 1905, viii, 321 (363) (a chemical process).
[5] HT, iv, 18 f.
[6] HT, III, cxciv f.; Festugière, (1), i, 88; Zielinsky, *A. Rel.*, 1905, viii, 321 (365).
[7] Berthelot, (3), 86 f.; Bouché Leclercq, 517–42; Cumont, (5); Diels, *Abhl. Akad. Berlin, phil.-hist. Kl.*, 1906, 43–8; Fabricius, (1) (*a*), i, 60; (1) (*b*), i, 66; Festugière, (1), i, 89–186; *id.*,

to us. The earlier works contain the Stoic doctrine of 'sympathy' (see p. 162) and there is no characteristic Hermetic occultism in them.[1]

Περὶ βοτανῶν χυλώσεως[2] is a treatise on astronomical botany of Egyptian origin. Galen[3] quoted Pamphilos (1 cent. A.D.) as founding medicine on a book by the Egyptian Hermes containing a doctrine of 36 sacred plants. A work on twelve parts of plants related to the signs of the Zodiac, and similar works, are ascribed to Hermes Trismegistos.[4] Pliny's books xxiv–v are full of plant magic, citing many authors; there were rival schools of botany.[5] A *Sacred Book* (*ἱερὰ βίβλος*) *of Hermes to Asklepios*[6] explains how to find a plant and stone in sympathy, to engrave on the stone, and fix a bit of the plant under it in a ring, which is carried to cure a disease. There is a 'sugar plant', *σακχαράνιον* or *σαγχαρώνιον*.[7] The so-called Solomon text mentions helioscope, the plant of the sun, 'called by the Italians *girasole* (*τζιρασόλεμ*)', and the plant of the moon, *ἀγλαοφῶτις* or *παιωνία* or *τζηριτῶν* (peony), 'called among the Italians *lunaria*'; 'if you throw the stem of the plant or its root on to any metal, and melt it, you will find the metal become like pure gold, quite brilliant and genuine'.[8] A treatise on fifteen stars, stones, plants, and magic images, ascribed to Hermes or to Enoch, is a Latin translation of a text of Māshāllāh, the Arabic astrologer, d. 815 or 820. It refers to Hermes Abhaydimon (Agathodaimon), Plato, Demokritos, Aristotle, the Persians, etc., and the four noble sciences of astrology, physics, magic, and alchemy.[9]

There are longer astrological treatises attributed to Hermes.[10] Harpokration of Alexandria (*c.* A.D. 120, or 4 cent. A.D.)[11] reported that Nechepso chose stones and plants as amulets according to their natural sympathies with the stars, which filled them with their effluvia.[12] This theory, fully developed by Proklos (see p. 232), passed to the Ṣābians of Ḥarran.[13]

HT, III, xxxix f.; W. Gundel, (*a*) Dekane und Dekan Sternbilder, in *Stud. Bibl. Warburg*, 1936, xix (pp. 451); (*b*), *id.*, Neue astrologische Texte des Hermes Trismegistos, in *Abhl; Munich Akad., phil.-hist. Abt.*, 1936, xii (pp. 386); (*c*), *id.*, PW, Suppl. vii, 116–24 (Dekane). Kroll, PW, ix, 802; Morhof, (1), i, 88 (Vienna MSS.); Nock, (2).

[1] Festugière, (1), i, 355–62.

[2] Creuzer, (1), i, 395; printed in Lydus, *De Mensibus*, ed. Roether, Darmstadt, 1827: Schoell, 1830, iii, 606.

[3] *De Simpl. Med. fac.*, vi; Kühn, xi, 797–8; HT, III, xli; Conring, (1), 67 f. (spurious).

[4] Boll, CCAG, vii, 231 (attrib. to Ramon Lull); Festugière, (1), 77, 137–66; Gubernatis; Hopfner, (1), 261; Pfister, PW, xix, 1446; C. E. Ruelle, *Rev. Philol.*, 1908, xxxii, 247–77; D. W. Singer, CAMG, iii, 763–73.

[5] Festugière, (1), i, 138, 153.

[6] Pitra, *Analecta Sacra*, Paris and Rome, 1888, V, ii, 275–92 (284), for Harpokration, *ib.*, 292–9, *persica*, 300–8; Festugière, (1), i, 139.

[7] Festugière, (1), i, 147.

[8] Festugière, (1), i, 154 f. The *lunaria* had a long reputation among the alchemists: Read, (1), xxiv, 97–8, 178, 258–9.

[9] Festugière, (1), i, 160; Thorndike, (1), ii, 220; *Isis*, 1929, xiii, 75.

[10] Fabricius, (1) (*b*), i, 66 f.; Ideler, (1), i, 387–96, 430–40: an *Ἰατρομαθηματικὰ Ἑρμοῦ τοῦ Τρισμεγίστου*; is said by Kroll, PW, viii, 798, to be based on a work of Petosiris and Nechepso (probably the same person; tr. John Harvey, *The Learned Work of Hermes Trismegistus, intituled Iatromathematica*, in Ralph Williams, *Physical Rarities*, 2 ed., 1652.

[11] Bouché Leclercq, 536; A. B. Cook, ii, 612; Ganszyniec, PW, xii, 1883; Gossen, PW, vii, 2416; E. H. F. Meyer, ii, 340, 356; Schmitz DBM, ii, 352 (five of this name); Tannery, *Isis*, 1930, xiv, 428; Wellmann, *Philologus Suppl.*, 1934, xxvii (2), 12.

[12] Bouché Leclercq, 356, 534; Budge, (4), xxiv, 17, 20, 70, 87, 135, 202, 296, 306, 416, 423, 480; Chwolsohn, i, 743; Hopfner, PW, xiii, 767; xiv, 301, 326; Kroll, PW, viii, 792.

[13] Bouché Leclercq, 316 f.; Chwolsohn, i, 749 f.

Instruments and tables used in Iatromathematics include (i) the 'instrument (ὄργανον) of Hermes Trismegistos';[1] (the 'sphere (σφαῖρα) of Demokritos',[2] which was sometimes arranged in a circle; (iii) the 'kanonion (κανόνιον)' of Hermes Trismegistos;[3] and (iv) the 'circle of Petosiris'.[4] Horapollo[5] cites [I]ambres on such calculations.

KYRANIDES AND KOIRANIDES

A work ascribed to Hermes Trismegistos is the *Kyranides* or *Koiranides*; the first of the four books is on magic (with Greek, Mithraic, Babylonian, and Jewish elements) and deals mostly with plants, and the other three describe quadrupeds, birds, and fish, respectively. Books ii to iv at first formed a separate work. Under each letter of the alphabet are given the names of a bird, a plant, a fish, and a gem or stone beginning with that letter (in Greek). On the stone is engraved the figure of the bird with his feet on the fish, and the engraved stone is put into a bag with a bit of the plant and of the heart of the bird, when a powerful amulet is obtained. At the end of the fourth book the author promises to deal with metals, but the book ends (with 'Amen') before this part is reached.[6]

Reinesius[7] and Zielinski thought the name is derived from Kyrene, the work going from there to Egypt; Ganszyniec suggested that the correct form is *Kyranides*, from the Coptic *cheri nsthai*, 'engraved on stelae'; Kroll says that *Koiranides* is the correct name. Ganszyniec says Scaliger and Salmasius had derived the name from an Arabic word meaning 'collection' (which also occurs in *Qur'ān*); *Koiranides* has also been supposed to mean 'Queens among books'. The work was originally written in Greek, a translation from Syriac or Persian being apocryphal. The Greek text[8] has the title: [8]Βίβλος φυσικῶν δυνάμεων, συμπαθειῶν καὶ ἀντιπα- θειῶν . . . There are Latin[9] and English[10] translations.[11]

[1] Berthelot, (2), ii, 23.

[2] Leyden magic papyrus V (4 cent. A.D.), BN MS grec 2419, etc.; Berthelot, (3), 86; Bouché Leclercq, 538; Dieterich, (3), 788, 813 (Leyden pap. W = J395); Freeman, (1), 1949, 325; PGM, ii, 81 (London pap. CXXIII); VS, ii, 221.

[3] Bouché Leclercq, 541.

[4] BN MS grec 2419 (A.D. 1462); Berthelot, (3), 87–92, figs. 1–2, and description; Bouché Leclercq, 540; London Pap. XLVI, Budge, (2), 229.

[5] *Hieroglyphica*, i, 38; ed. Leemans, Amsterdam, 1835, 41, 250 (Leyden papyrus).

[6] Bidez, (2), i, 188–98; Boll, (1), 369; Bouché Leclercq, 316, 536; Cumont, *Bull. Soc. Antiq. France*, 1919, 175; L. Delatte, *Textes Latins et Vieux Français relatif aux Cyranides*, Liége and Paris, 1942 (Delatte was preparing a new Greek ed.); J. Evans, 18 f.; Fabricius, (1) (*a*), i, 62; vi, 190; xii, 755; (1) (*b*), i, 69; Festugière, (1), i, 180–216; Ganszyniec, *Byzantinisch-Neugriechische Jahrbücher*, 1920, i, 353–67; 1921, ii, 56, 445; *id.*, MGM, 1922, xxi, 213; *id.*, PW, xii, 127; Haskins, (1), 219; W. Kroll, PW, xii, 134; E. H. F. Meyer, ii, 277 f., 348 f., 353 f.; Morhof, (1), i, 98; Pfister, PW, xix, 1446; Reitzenstein, (2), 259, 270; Ross, OCD, 249; Serruys, *Rev. Philol.*, 1908, xxxii, 158; Sprengel, (1), ii, 159; Tannery, *Rev. Étud. Grec.*, 1904, xvii, 335; *Isis*, 1930, xiv, 428; Thorndike, (1), ii, 229; Wellmann, (6), (7), (8); Zielinski, *A. Rel.*, 1906, ix, 25 (50); Zuretti, CMAG, ii, 263–331; v, 73.

[7] In Fabricius, (1) (*a*), 1724, xii, 756.

[8] Ed. and tr. Ruelle and de Mély, *Les Lapidaires Grecs*, 3 pts., 1898–9–1902 (BM 7706. i. 22).

[9] *Moderante Auxilio Redemptoris Supremi, Kirani Kiranides, Et ad eas Rhyakini Koironides*...; second t.p., Leipzig, 1638 (BM 957. b. 9); 2 ed., 12°, Frankfurt, 1681 (Fabricius, (1) (*b*), i, 72).

[10] *The Magick of Kirani, King of Persia, and of Harpocration; Containing the Magical and Medical Vertues of Stones, Herbs, Fishes, Beasts and Birds* . . . , 8° [London ?], 1685 (BM 1141. a. 15).

[11] One Latin translation is by 'domino magistro xxxRA. PA', which E. H. F. Meyer, ii, 350, thought means 'Raimundus Palmensis' (Raymund Lull, b. Palma), but Thorndike, (1), ii, 230, a dedication to a superior, perhaps the Chancellor at Paris, and the translator may have been Plato of Tivoli.

Wellmann supposed that the author of the works was Bōlos of Mendes (*c.* 200 B.C.), who used the Greek works used by Pliny, Dioskourides, and the author of the *Physiologos*, but reproducing them better. It was perhaps re-edited by Harpokration of Alexandria (4 cent. A.D.), but the present Book i is Byzantine (4–8 cents.). The oldest Latin translations are apparently from Arabic translations of the Greek, and show Syrian influence. Wellmann thought the collection was first put together in the 1 cent. A.D. from three separate documents:

(i) An ἀρχαικὴ βίβλος, meaning 'book of causes' rather than 'ancient book' (ἀρχή also means 'origin'), corresponds with a book on animal magic related to the Φυσικά (*Physikā*) of Bōlos and the Essene ἱερὰ βίβλοι, and contributed to the present first book.

(ii) A Κυρανίς (*Kyranis*) named after a mythical Kyranos, King of Persia, was said in the text to form book i. There is nothing Persian in it.

(iii) A *Koiranides*, forming the books ii–iv, a Φυσικὰ δυναμερά (*Physika dynamera*) attributed to Hermes Trismegistos. The foundations go back to the 3 to 2 cents. B.C. and the work was compiled in Egypt. The physician Marcellus of Side (time of Hadrian to Marcus, A.D. 117–217) used them in his poem Ἰατρικά, which continues the traditions of the Neopythagorean Φυσικά. The alchemist Olympiodoros (4 cent.) quotes ἐν τῇ κυρανίδι ὁ Ἑρμῆς . . . ἐν τῇ ἀρχαϊκῇ βίβλῳ (i.e. one book),[1] and Synkellos (9 cent.)[2] ἐν τοῖς . . . κυραννίδι βίβλοις. The mole, used by later alchemists, is mentioned both by Olympiodoros and in the *Kyranides* as exiled in the black earth because it revealed 'the mystery of the sun' (i.e. of gold).[3] The legend of the stone in the toad's head first appears in the *Kyranides*.[4] ψ-Loukian (2 cent.)[5] after describing remedies for gout (plants, excrements, unpleasant animals, metals, etc.) says a treatment can be found in the *Kyrannes* (Κυράννης, i.e. Κοιράνου ?).

PHYSIOLOGOS

The *Physiologos* is a kind of bestiary containing descriptions after a fixed plan for each animal, plant or stone: a Biblical account, then the 'wonder' stories, and finally the allegorical-mythical interpretation. It was supposed to have been written in Alexandria but Wellmann thinks the original was composed about A.D. 254–380 in Caesarea, perhaps by a Palestinian Jew under Syrian influences. The basis was a Φυσικά (not a specific zoological work) of the 1 cent. A.D. (from which the author of the *Koiranides* also compiled) which contained many Oriental ideas of a magical, mystical and superstitious character on φύσεις (the occult properties of natural objects). Such works, much used by Neopythagoreans (e.g. Nigidius Figulus), Essenes, Hermetic writers, etc., were regarded as important in the early Christian Church. The author of the *Physiologos* may have been Didymos of Alexandria (*c.* 300 A.D.;

[1] Berthelot, (2), ii, 101; Sprengel, (1), i, 158.
[2] (1), 52; (2), 97; Fabricius, (1) (*a*), i, 62; xii, 755; E. H. F. Meyer, ii, 277 f., 348 f., 355.
[3] Festugière, (1), i, 214.
[4] J. Evans, 19; Philostratos, *Apollonios of Tyana*, iii, 8.
[5] *Tragodopodagra*, ll. 171 f.; Festugière, (1), i, 205; Helm, PW, xiii, 1729 (spurious).

not the grammarian), an imitator of Bolos through Anaxilaos. Other sources were a 2-cent. Syriac bestiary of Tatian, also using Bolos and used in turn by Timotheos of Gaza (*c.* 500), and a scientific book of a Jewish author (or one under Jewish influence) resembling the *Physika* of 'the great magician Solomon'. There are references to magic Indian stones, agates detecting pearls, the magnet, male and female igniting and ignitable stones, and the diamond, resisting fire but mastered by hot blood (some parts resemble the work of ψ-Plutarch, see p. 223). There are translations or fragments in Armenian, Syriac, Ethiopian, and European languages.[1]

[1] Greek text, ed. F. Sbordone, Paris, 1939. See Festugière, (2), III, cxcviii; Kraus, (2), 61 f.; Mewold, *D. Lit. Ztg.*, 1930, li, 2171; Perry, PW, xx, 1074–1129; F. Sbordone, *Ricerche suell fonti e sulla composizione del Physiologus Greco*, Naples, 1936; Stählin, in Christ, 1913, II, ii; 1212; Stephanides, *Isis*, 1925, vii, 257; J. A. Stewart, (1), 17; Thorndike, (1), i, 490; ii, 433, Wellmann, (6), esp. 85 f., 94 f., 112 f.; (7), 9 f., 16, 39; MGM, xvi, 374.

CHAPTER XIII

GNOSTICISM

Gnosticism is the modern name for a group of diverse systems which developed mainly in the 2–3 cents. A.D. and diverged to different degrees from the doctrine of the Catholic Church. Its origins are probably pre-Christian but these were relatively unimportant.[1] Except for some Coptic works, the original documents are lost, and only fragments by hostile Christian authors remain.[2] These include Justin Martyr (Nablus; *c.* A.D. 120–*c.* 165),[3] St. Irenaeus (Smyrna; *c.* A.D. 130–5—? 202), Bishop of Lyons in 178,[4] whose work (except for a few fragments, some in Syriac) is known only in Latin (*Adversus Haereses*) not later than the 4 cent,[5] St. Hippolytos (*c.* 170–5—*c.* 236), anti-pope in the time of Pope Callistus (from 217), who was deported to the mines in Sardinia in 235 and probably died there.[6] Tertullian of Carthage (A.D. 155/60–220/30),[7] wrote *De praescriptione haeresium* (A.D. 200), *Adversus Valentinianos* and *Adversus Marcionem* (A.D. 207–8) against the gnostics Valentinus and Markion;[8] the *Libellus adversus omnes haeresis* printed as an appendix to the

[1] Amélineau; Anz; J. P. Arendzen, CE, vi, 592; G. Bareille, DTC, 1915, vi, 1434–67; Baur. (1); L. Blau, JE, v, 681; W. Bousset, PW, vii, 1502–33 (Gnosis), 1534–47 (Gnostiker); *id.*, (1); *id.*, EB[11], 1910, xii, 152; *id.*, *A. Rel.*, 1901, iv, 136, 229; Buoniauti; F. C. Burkitt, *Church and Gnosis*, Cambridge, 1932; R. P. Casey, *J. Theol. Stud.*, 1935, xxxvi, 45–60; Deussen, (1), II, ii, 328; Dodd, (2), 97–114; Duchesne, 1909, i, 112–42, 328; de Faye; L. Fendt, *Gnostische Mysterien. Ein Beitrag zur Geschichte des christlichen Gottesdienst*, Munich, 1922; Festugière, (1), iv (le Dieu inconnu et la Gnose); R. M. Grant, (1), *Second Century Christianity. A Collection of Fragments*, 1946; (2) *Gnosticism and Early Christianity*, New York, 1959; Hilgenfeld, (1); Inge, (1), 1929, i, 103–8; M. Joël, (1), i, 103–70; H. Jonas, Gnosis und spätantiker Geist, *Forschungen zur Religion und Literatur des Alten- und Neuen Testament*, 1934, xxxiii; 1954, xlv; G. A. Jülicher, *E. Bibl.*, 1901, ii, 1738; Kennedy; C. W. King, (2); W. Köhler, *Gnosis*, Tübingen, 1911; J. Kroll, (1); D. G. Krüger, (1), 43; F. H. Krüger, *La Grande Encyclopédie*, [1894], xviii, 1129–30; J. Kunze, *De Historiae Gnosticismi Fontibus*, Leipzig, 1894; H. Leclercq, DACL, 1924, vi, 1327–67; Leisegang, (1); R. A. Lipsius, (1) Ersch-Gruber, 1860, lxxvii, 223–305; H. L. Mansel, *Gnostic Heresies of the First and Second Centuries*, ed. J. B. Lightfoot, 2 ed., 1875; J. Matter, (2); E. Meyer, (2); Noack, (1), 314; A. D. Nock, (3); Norden, (1), 65, 69; G. Quispel, *Gnosis als Weltreligion*, Zürich, 1951; Reitzenstein, (1), (2), (4), (5); Sagnard, (1), (2); G. Salmon, DCB, ii, 678; E. H. Schmitt, *Die Gnosis*, 2 vols., Leipzig, 1902–7; H. J. Sheppard, *Ambix*, 1957–8, vi, 86, 140; 1957, vii, 42; W. Schultz; E. F. Scott, ERE, vi, 231; Scott-Moncrieff; O. Stählin, in Christ, 1913, II, ii, 1044–64; Thorndike, (1), i, 360; Tondelli; Ueberweg, (1), ii, 26; W. Völker (texts); Wendland, 161.

[2] Arendzen, 599–601.

[3] *Works*, Migne, PG, 1857, vi; tr. M. Dods, G. Reith, and B. P. Pratter, ANL, 1868, ii; Lietzmann, PW, x, 1332; Uebermeg, (1), ii, 15.

[4] D. G. Krüger, (1), 91; Lipsius, DCB, iii, 258; Sagnard, (1), 31–50 (text), 56, 142; Ueberweg, (1), ii, 41.

[5] PG, 1857, vii, 431–1224; ed. (with Syriac fragm. and introd.) by W. Wigan Harvey, *Sancti Irenæi Libros quinque adversus Haereses*, 2 vols., Cambridge, 1857; tr. A. Roberts and W. H. Rambaut, ANL, 1868, v; 1869, ix; and by J. Keble, 1872 (from Harvey's text).

[6] Buonaiuti, 18; Legge, (2), i, 20 f.; Sagnard, (1), 11, 143, 224; Salmon, DCB, iii, 85; Ueberweg, (1), ii, 44.

[7] D. G. Krüger, (1), 93, 159.

[8] *Opera*, Migne, PL, i–iii; tr. Holmes, ANL, 1868, vii.

first is spurious and was probably by Victorinus of Petau (early 4 cent.),[1] and St. Epiphanios of Judaea (*c.* A.D. 315–403) went early to Egypt, became Abbot of Eleutheropolis and Bishop of Constantia in Cyprus in 367, and completed (*c.* A.D. 374–7) a *Panarion* ('bread-basket' or 'medicine-chest'), dealing with 80 heresies, including Jewish and heathen philosophies.[2] Minor sources are Philastrius of Brescia (*c.* A.D. 383) (*Liber de Haeresibus*)[3] and Theodoret of Cyr (on the Euphrates) (*c.* A.D. 453) (*Haereticarum Fabulae*)[4].

The first book of Hippolytos was published with the title *Philosophumena* as a work of Origen, but a large work in ten books, probably with the title *Refutation of all Heresies* (κατὰ πασῶν αἱρέσεων Ἔλεγχος), was discovered in a unique 14-cent. Mount Athos MS. in 1842 and published by E. Miller.[5] Books (ii) and (iii) and part of (iv) are missing, and the summary in book (x) does not mention their contents. The first book deals with Greek philosophers, the fourth with astrologers and magicians, the discussion of the heretics begins in book (v). Bunsen (1852) and Wordsworth (1853) ascribed the work to Hippolytos and this is now accepted. It was perhaps composed late in his life, from a collection of texts made by a gnostic;[6] the theory[7] that the earlier parts are from forged documents is not now accepted.[8] He shows a good knowledge of Indian religion.[9] To 'expose' a heresy, Hippolytos, following Irenaeus,[10] tried to show that it could be found in Greek philosophy and not in the Bible.[11] The work contains the mathematical idea of an infinity of the second order (ἀριθμὸν ἀπειράκις ἄπειροι).[12] Irenaeus and Hippolytos describe gnosticism of about A.D. 180.[13]

'Gnosticism is one of the most flexible designations in the vocabulary of the history of religion.'[14] It was a many-sided movement and contained so many components that it is difficult to present a coherent picture of its origins and contents.[15] The name 'gnostic' for a Christian sect was first

[1] Ed. F. Oehler, i, 271 f.
[2] *Epiphanius Opera*, ed. Petavius (Denis Petau, Orleans, 1583–Paris, 1652), 2 vols. f°, Paris, 1622 (reprinted Cologne (really Leipzig), 1682) (*Panarion* in vol. 1); Migne, PG, 1858, xli–xliii; ed. Dindorf, 5 vols., Leipzig, 1859; *Panarion*, ed. F. Oehler, (1), II, i, ii, iii; III; Dindorf, iv, 141; Holl, GCS, 3 vols., 1915–22–33. Epiphanios also wrote a *De gemmis* (after A.D. 392), and on weights and measures (περὶ μέτρων καὶ σταθμῶν), mostly grammatical (ed. Petavius, ii, 158–84); a bestiary (*Physiologos*) (*id.*, ii, 189–224) is spurious. The *De numerorum mysteriis* (*ib.*, ii, 304–9) deals with the numbers 3 and 7. R. P. Casey, *J. Theol. Stud.*, 1929, xxiv, 34; Duchesne, ii, 467; Lipsius, DCB, ii, 149; Sagnard, (1), 11; Schoell, iii, 315; Thorndike, i, 494.
[3] Migne, PL, xii, 1111–1302; Oehler, (1), i, 1 f.
[4] Migne, PG, 1859, lxxxiii, 339–555; Sagnard, (1), 11.
[5] *Origenes Philosophumena*, Oxford, 1851 (Greek text only).
[6] Bousset, EB[11], 1910, xii, 152; Krüger, *ib.*, 519.
[7] Salmon, *Hermathena*, Dublin, 1885, v, 389; DCB, 1882, iii, 85; H. Stähelin, Die gnostische Quellen Hippolyts, TU, 1890, vi, no. 3.
[8] Bousset, PW, vii, 1506; de Faye, 243; Legge, (2), i, 8, 20; Scott, ERE, vi, 239, 242.
[9] *Refut.*, i, 24; Filliozat, *Rev. Hist. Rel.*, 1945, cxxx, 59.
[10] II, xiv, 2–6.
[11] Legge, (2), i, 41; Sagnard, (1), 224 f.; Strinopulos, *Hippolyts philosophische Anschauungen*, *Dissert.*, Leipzig, 1903.
[12] *Refut.*, i, 2, p. 10; Salmon, 1885.
[13] Buonaiuti, 22.
[14] Kennedy, 23, 26.
[15] Anrich, 35 f., 42, 71, 76, 166; Bousset, PW, vii, 1516; R. P. Casey, *J. Theol. Stud.*, 1935, xxxvi, 45; Dieterich, (1), 126, 148; de Faye, 520 f.; Gundel, PW, vii, 2633; W. Köhler, 7, 19; Nock, (3); Pallis, (1), 11, 19 f., 32, 35; Scott, ERE, vi, 236.

used by Celsus (A.D. 178);[1] 'gnosis' is a technical term, an abbreviation of γνῶσις θεοῦ, 'knowledge of god', achieved by direct union with a god, a perfection (τέλος), transfiguration (μορφοῦσθαι, μεταβαλλεσθαι), or rebirth (παλιγγενεσία).[2]

The gnostics sought the answers to many serious problems: the eternity or creation of matter; the relations between God, the material world, and man; the creation, fall, and redemption of man; and particularly the origin, utility, and final extinction of evil (*unde malum et quare*). They attempted to make the old religions 'rational' on the basis of Greek philosophy.[3] In the Roman period, gnosticism was influenced by Stoicism, and some systems are more or less penetrated by Oriental ideas, coming either directly or through Poseidonios.[4] Of great importance was a knowledge of the structure of the higher world and how to get there.[5] In some forms (the Ophites and *Pistis Sophia*) the emphasis is on magic words (names of demons), prayers and sacraments.[6] The gnostic systems lived on a few basic ideas:[7] the highest god is different from the creator of the world or the Old Testament God (sometimes regarded as an evil being); matter exists and is eternal and evil; the present world is the result of a 'fall', or a mistake made in its creation by an evil, weak, or ignorant being; the aeons are real forces and the aeon Christ is different from the man Jesus; the soul has fallen from a higher world and can be released from imprisonment in matter only by a saviour god who descends for that purpose; and there are various classes of men, only the gnostics (πνευματικοί) being capable of salvation.[8]

Various views have been held as to the origin of gnosticism.

(1) It is 'an acute Hellenisation of Christianity' which arose in Christian circles[9] as an attempt to produce a 'philosophy' based on Plato.[10] Christian gnosticism began in the 1 cent.[11]

(2) Even if Syria was the original home of gnosticism,[12] it was in Alexandria, where the ancient Egyptian religion persisted till the 5 cent., that the main gnostic sects developed from diverse Greek and Oriental components under the influence of Christianity; Christian gnosticism reached its climax in A.D 130–190 and in the 5 cent. its force was spent.[13]

There is little specifically Egyptian in gnostic systems; Egyptian works such

[1] Origen, *Contra Cels.*, v, 60.

[2] Anrich, 81; Bousset, EB[11], 1910, xii, 152; *id.*, (1), 313, 321, 365; *id.*, *A. Rel.*, 1901, iv, 148, 151; Festugière, (1), iv, 57; J. Kroll, (1), 350, 361 f.; Reitzenstein, (2), 158; (4), 1910, 26, 33, 179; *ib.*, 1927, 66, 285–333; Scott, ERE, vi, 231.

[3] Sagnard, (1), 105; Salmon, DCB, ii, 678; Schaeder, (2), 100.

[4] R. P. Casey, OCD, 390; Hopfner, PW, xiv, 307; Tondelli, 163.

[5] Bousset, PW, vii, 1524; Dodd, (2), 101; Scott, ERE, vi, 234.

[6] Bousset, PW, vii, 1521; J. Kroll, (1), 350 f.; W. Schultz, 74.

[7] Bousset, (1), 7; Buoniauti, 10.

[8] Harnack, (2), i, 277–89; Scott, ERE, vi, 235–6.

[9] Harnack, (1), 459; (2), i, 243–91 (esp. 248, 250 f., 264, 266, 269).

[10] Noack, (1), 314.

[11] Jülicher, *E. Bibl.*, 1901, ii, 1738; E. Meyer, (2), 1921, ii, 371 f.; 1923, iii, 279, 293–8, 537, 625.

[12] Bousset, (1), 5; PW, vii, 1503, 1545.

[13] Amélineau, 139, 281–328; Anrich, 46 f., 75 f., 81; Bidez, (1), 233 f., 248; Bousset, PW, vii, 1524 f.; Burkitt, (4); *id.*, *J. Egypt. Archaeol.*, 1932, xviii, 182; Cumont, (1), 123, 196; Dieterich, (1), 126, 143, 148 f.; *id.*, (2), 206; de Faye, 469 f. (see Lietzmann, *A. Rel.*, 1921, xx, 455); P. Monceau, *J. des Sav.*, 1918, xvi, 12, 69, 140, 152); Reitzenstein, (2), 14, 159, 247; Scott, ERE, vi, 231.

as *Pistis Sophia* include Hellenistic, Persian, and Jewish ideas and are relatively late.[1] Some gnostic hymns and prayers are interpolated in Egyptian magic papyri, but the association is slender.[2]

(3) There are some Jewish elements,[3] but some systems are anti-Jewish,[4] and the Jewish sources were under Babylonian and Iranian influences.

(4) Some gnostic systems show signs of dualism (good and evil powers), and an influence of Iranian beliefs has long been recognised.[5] Some earlier forms (Naassenes, Ophites) are pre-Christian.[6] Iranian influence was emphasised by Bousset and Reitzenstein; Reitzenstein[7] thought that although it might show some influences from Orphicism, Plato, and Poseidonios[8], the gnostic system was ultimately Iranian.

(5) Babylonian star worship was modified by Persian ideas, in which the gods of the planets became evil demons (*archons*) who opposed the ascent of the soul unless propitiated by prayers or offerings, or compelled by magic formulae or the utterance of their 'true names' (this was more an Egyptian idea), knowledge (γνῶσις) of which in the original language (Egyptian or Babylonian) was essential.[9]

In a Babylonian legend[10] the goddess Ishtar (Venus) descends into Hades through seven gates, opened at her command by their guardians, to whom she surrenders pieces of her clothing, receiving these back on her re-ascent. Iranian features, according to Anz, Bousset, and Reitzenstein are: (1) a supreme unknown god and seven archons or planetary spirits, (2) a fall and re-ascent of man, (3) a pre-existing Man or Adam, and a Son of Man, and (4) a divine mother. Their conclusions have been criticised.[11] The higher forms of gnosticism rejected magic.[12]

(6) Indian influence on some later forms of gnosticism is possible but unimportant.[13]

The Unknown Father (Πατὴρ ἄγνωστος) in gnosticism corresponds with the Highest God (Θεὸς ὕψιστος) in late Jewish literature.[14] The Mother, also called Sophia, Prouneikos, Achamoth, Barbelo, the Left, the Mother Above, the Virgin of Light, in Manichaeism Mother of Life, and in late Jewish literature Shekinah, present in many gnostic systems, is probably originally

[1] Schubart, (3), 315. [2] Dieterich, (1), 2, 151; Nock, (3).

[3] Amélineau, 139; Dieterich, (1), 137, 155, 161, 165, 187, 189, 197, 203; M. Joël, (1), i, 103 f.; J. Matter, (1), 1828, i, 33, 55 f. (Philo), 74 f., 93 f., 100 f., 112 (Talmud), 171, 174; Scott, ERE, vi, 231; Verbeke, 223.

[4] Bousset, (1), 215; PW, vii, 1525.

[5] J. Matter, (1), 1828, i, 24, 33, 76 f., 100, 115, 130 f., 139, 148, 178.

[6] Festugière, (1), iii, 33; Grant, (2), 13 (thinks only inferred); Nock, (3); Sagnard, (1), 112, 116.

[7] (5), 92. [8] J. Kroll, (1), 350 f., 386.

[9] Anz, TU, 1897, xv, no. 4, 54, 64, 88, 90, 97, 107; Bousset, (1), 21 f., 44, 46, 116, 118, 159, 328; *id.*, PW, vii, 1503; Dieterich, (1), 43, 132, 148; Kennedy, 24 f., 29; Legge, (1), i, 90 f., 101, 110 f., 148; ii, 88; Verbeke, 287–306.

[10] Jeremias, 65; Meissner, ii, 24, 183.

[11] R. P. Casey, in *The Background of the New Testament and its Eschatology, in honour of C. H. Dodd*, ed. W. D. Davies and D. Daube, Cambridge, 1956, 52; Dodd, (2), 98; Sagnard, (1); Scott, ERE, vi, 233.

[12] Tarn, (1), 318.

[13] H. I. Bell, (4), 92; Filliozat, *Rev. Hist. Rel.*, 1945, cxxx, 59; Hopfner, PW, xiv, 307; J. Kennedy, J. Ras., 1902, 377–415; 1917, 209–43, 469–540 (Basilides); C. W. King, (2), 42, 117, 165, 258 f., 266.

[14] Bousset, (1), 83 f., *id.*, *A. Rel.*, 1901, iv, 151; J. Kroll, (1), 1 f.; Tarn, (1), 195.

the Great Mother of Asia Minor (*Syria Dea*), forms of which were Atargatis, Cybele, Astarte, and Anaïtis (Persian), but the Babylonian Ishtar and Egyptian Isis are possible.[1]

Simon Magus

Simon the Magician (Magus) of Gitta in Samaria, who is mentioned in Acts viii, 9–24, appeared in Rome in the time of Claudius (A.D. 41–54), representing himself as a divinity, the founder of a religion, and the possessor of knowledge (gnosis) which ensured salvation and enabled him to work miracles (see p. 276). He was accompanied by a woman Helena; Simon said she was a reincarnation of Helen of Troy, but Epiphanios says she came from Tyre.[2] Simon said there was a Power of immense and ineffable light, unknown to the maker of the imperfect world, to Moses, and Jesus; from this everything began, including souls which descended to captivity in the world.[3] Epiphanios says Simon claimed to have descended through the heavens, each guarded by a spirit, addressed by him in barbaric names. By means of magic learnt in Alexandria Simon said his flesh was 'so compacted by the power of his divinity that it can endure to eternity', hence he called himself the Standing One (ὁ ἑστώς).[4] The world, obviously imperfect, was created by the Demiurge (Δημιουργός), not by the unknown highest god.[5] Hippolytos[6] quotes from Simon's book, *The Great Declaration* (μεγάλη ἀπόφασις), probably a later product of his school, that there was an incomprehensible (ἀκατάληπτος) bisexual Supreme Principle, which is fire of two kinds, sensible and hidden, and under it three groups of male-female principles making 'six roots' (ῥίζας), sometimes heaven and earth, sun and moon, air and water, sometimes abstract principles, reason (νοῦς) and thought, voice and name, number (λογισμός) and idea (ἐνθύμησις). The members of the supreme fire, 'like a great tree', possessed intelligence and a portion of mind. The blood is hot and red like fire; in the male it forms sperm, in the female milk. Hippolytos traced these ideas to Aristotle. Menander of Samaria (*c.* A.D. 125), a pupil of Simon, held similar views.[7] Tertullian says he baptised in water which he pretended was from the Styx.

Karpokrates was apparently a Platonist or Christian of Alexandria (*c.* A.D. 150–200).[8] Clement of Alexandria[9] says the Karpokratians taught a single

[1] Anz, 91; Bousset, (1), 9 f., 11, 26, 57 f., 61, 160, 322, 335, 394 (index); *id.*, PW, vii, 1513 f., 1537; Box, in A. S. Peake, 437, 451; Deussen, (1), II, ii (1), 310; Gressmann, (1), 56; Legge, (1), i, 90 f.; Leisegang, PW, II Reihe, iii, 1019–39; Lipsius, DCB, iv, 712; ψ-Loukian, περὶ τῆς Συρίης θεοῦ (*De Dea Syria*), tr. H. A. Strong and J. Garstang, *The Syrian Goddess*, 1913; Oesterley, in A. S. Peake, 336 f., 346; Salmon, DCB, ii, 850; iii, 908; iv, 71; Schultz, 50, 62, 67; Scott, ERE, vi, 231 f.; Waite, (1), 190 f.

[2] Epiphanios, *Panar.*, xxi; (1), i, 55 f.; Hippolytos, vi, 7–20; x, 12; Irenaeus, I, xxiii, 1–5; Tertullian, *De idolat.*, 9; *De anima*, 34, 57; Amélineau, 24–51; Bousset, (1), 78; Casey, in F. Jackson and Lake, v, 151; Eisler, (1), 478; F. Huelsen, *De Simonis Magi vita atque doctrina*, Berlin, 1868; Leisegang, (1), 1941, 60–110; Leitzmann, PW, II Reihe, iii, 180; J. Matter, (1), 1828, i, 185 f.; E. Meyer, (2), iii, 277–302; Salmon, DCB, iv, 681; Schultz, 38, 136; Thorndike, (1), i, 362, 400; Völker, 1 f.; Waszink, 401 f.

[3] ψ-Clement, *Recog.*, ii, 49, 53–4, 57, 61.

[4] ψ-Clement, *Homil.*, ii, 22; *Recog.*, ii, 7.

[5] *Homil.*, xviii, 1.

[6] *Refut.*, vi, 11; (1), 240.

[7] Irenaeus, I, xxiii, 5; Tertullian, *De Anima*, 50; Amélineau, 1887, 52–66.

[8] Amélineau, 1887, 153–65; Salmon, DCB, i, 407; Völker, 1932, 33.

[9] *Strom.*, III, ii.

first principle (μοναδικὴ γνῶσις). Irenaeus[1] says the Karpokratians practised magic, and used philtres and other black arts. They were tattooed on the back of the lobe of the right ear, had pictures of Christ, made by order of Pilate, and honoured Christ equally with the Greek philosophers. Tertullian,[2] Hippolytos[3] and Epiphanios[4] give much the same account. Leisegang[5] thinks the Karpokratians were named after Horus-Harpokrates, the Alexandrian god, since Origen[6] calls them 'Harpokratians' and says they had traditions derived from Salome and Mariamne.

Naassenes

The Naassene system is reported by Hippolytos[7] from a book *On Man* containing Greek, Egyptian, Assyrian, Chaldaean, Samothrakian, and Phrygian myths. It was apparently a Hellenised Phrygian cult.[8] Reitzenstein[9] reconstructed a 'Naassener-predigt' as the 'oldest document of heathen gnosis'. It deals with a bisexual primary man Adam, who had various names, Attis being the oldest, and a good serpent Naas (Hebrew *nachash*). A reminiscence of the primeval Adam, 'according to the Chaldaeans, Parthians, Medes, and Hebrews', is found in the alchemist Zosimos (A.D. 250–300), who says that the archons persuaded, against its will, the Light in Paradise to enter the Adam (ἐνδύσασθαι τὸν 'Αδαμ) they had made from the four elements.[10] The Naassene first principle was Man and Son of Man,[11] bisexual, containing the three natures, τὸ νοηρόν (spiritual), τὸ ψυχικόν (psychic) and τὸ χοϊκόν (bodily). From the living or primeval water he supplies, each draws what his own nature attracts, as from the same natural water the olive draws oil and the vine draws wine, chaff is attracted by amber, iron only by the magnet, and gold only by the prickle of the sea-hawk (κερκὶς θαλασσίου ἱέρακος).[12]

Hippolytos[13] says the Naassenes had 'three greatest words': Kaulakau (Καυλακαῦ), meaning that which is above is Adam, Saulasau (Σαυλασαῦ), meaning that which is below is mortal, and Zeesar (Ζεησάρ), meaning the Jordan flowing above. Epiphanios[14] (who gives the first as καυλακαύχ) knew that they were from the Hebrew (Isaiah xxviii, 10: A. V. 'precept upon precept, line upon line, here a little'). The 'Jordan flowing above' is the symbol of the serpent Naas or Ophis, with its tail in its mouth (ἓν τὸ πᾶν).[15]

Reitzenstein's view that the Naassene account, ultimately Iranian, is the

1 I, xxv, 1–6; xxxi, 2; II, xxxi, 1.
2 *De anima*, 35.
3 *Refut.*, vii, 32.
4 *Panar.*, XXVII; (1), i, 102.
5 (1), 1950, 257 f., 265 f.
6 *Contra Cels.*, v, 62.
7 *Refut.*, v, 6–11; (1), 130; Mead, (1), i, 141; Schultz, 35; Scott, ERE, vi, 234; Völker, 11 (text).
8 Leisegang, (1), 1941, 132.
9 (2), 81; new text in *id.*, (5), 161; in (4), 1927, 12, he said the Jewish parts should have been retained; (6), 42, 63.
10 Berthelot, (2), ii, 230, 15; 231, 15; Reitzenstein, (2), 104. This is more closely related to Manichaean ideas: Bousset, (1), 46, 50, 190, 192, 207, 216, 334.
11 Bousset, (1), 160 f., 202 f.; Dodd, (2), 241; Kraeling, (4); Legge, (1), I, lxiii; Reitzenstein, (2), 81.
12 Hippolytos, *Ref.*, v, 9; (1), 172; for the Sethians, *ib.*, v, 21; (1), 213, κερκίς becomes κέντρον, with the same meaning; Salmon, DCB, iv, 85, 88; Schultz, 99, 105.
13 *Ref.*, v, 8; (1), 150; M. Joël, (1), i, 141.
14 *Panar.*, XXV, iv; (1), i, 78.
15 Leisegang, (1), 1941, 141; cf. Genesis ii, 10; Hippolytos, v, 9; (1), 172.

basis of Gnosticism, has been criticised:[1] Anthropos is peculiar to the Naassenes and Barbelo gnostics (see p. 258), and is not fundamental in gnosticism.

Ophites

Many gnostic sects of different dates who agreed in venerating the serpent (ὄφις) were called Ophites.[2] They probably arose in the I cent. A.D. and were originally non-Christian and related to the Naassenes. In the Bible the serpent in the garden of Eden gave Adam and Eve knowledge (γνῶσις) of good and evil, and Moses set up a bronze serpent in the wilderness.[3] The Ophites thought the serpent was really good and was willing to instruct mankind. The serpent appears in many old Greek and Oriental myths and religions. The serpent with its tail in its mouth symbolised 'the all (ἓν τὸ πᾶν)'. In Philo of Byblos[4] it is a 'pneumatic' (πνευματικώτατον) being.

The Iranian dualism of good and evil divine powers was paralleled in the later Greek opposition of the good world of spirit (πνεῦμα) and the evil world of matter (ὕλη). The world is a mixture of these, the work of a subordinate god, the Demiurge (Δημιουργός) of Plato, assisted by planetary demons, all (through Persian influence) evil, the most powerful being the evil spirit of Saturn, Ialdabaoth, identified with Kronos, Chronos, Iao (really Jupiter) and especially Yahwe, the god of the Jews, full of deceitful trickery (ἐνέδρευον ψεῦδος).[5] The belief that the body of man was formed by the seven planetary spirits (archons) but the soul was imparted, unknown to them, by a higher spiritual being is common to several gnostic systems.[6]

Epiphanios[7] used the name 'Ophites' for a sect called 'Gnostics' by Irenaeus,[8] who gives an account of their teaching. The seven planets, called Ialdabaoth, Iao, Sabaoth, Adoneus, Eloaeus, Oreus, and Astaphaeus formed a Hebdomas, and with their mother, Sophia or Prounikos, an Ogdoas (7 + 1 = 8). Six planets formed a man, into which Ialdabaoth breathed the breath of life, and so emptied himself of his power (light).

The most interesting Ophite system is given by Celsus (A.D. 178),[9] who describes a magic Ophite diagram formerly used by Christians which he had seen but did not understand. Origen himself[10] believed in the ascent of the soul 'through the places which the Greeks called spheres (σφαῖρα) but the Holy Scriptures call heavens'. Attempts to reconstruct the diagram[11] led to

[1] Bousset, (1), 194, 204, 210, 319 (Indian and Jewish elements); Dodd, (2), 111; de Faye, 407; J. Kroll, (1), 64 f.; E. Meyer, (2), ii, 345 f.; Wendland, 177; Wesendonk, (1), 153, 206, 208.

[2] Amann, DTC, 1931, xi, 1065; Bornkamm, PW, xviii, 654; Bousset, PW, vii, 1537; R. P. Casey, Naassenes and Ophites, *J. Theol. Stud.*, 1927, xxix, 34; Hilgenfeld, (1), 241, 250 f.; J. Kroll, (1), 237; E. Küster, Die Schlange in der griechischen Kunst und Religion, RVV, 1913, xiii, 94 (Ophites I cent. A.D.); Legge, (1), ii, 37; Leisegang, (1), 1941, 115–85; Lipsius, Ueber die ophitischen System, *Z. wiss. Theol.*, 1864, vii, 37–57; J. Matter, (1), 1828, ii, 184 f.; Salmon, DCB, iv, 80; Schultz, 50; Scott, ERE, ix, 499 (the serpent is subsidiary in Irenaeus); Völker, 11.

[3] W. Smith, (6), 849. [4] FHG, iii, 572.

[5] Bousset, (1), 22, 115, 351; PW, vii, 1503; E. Meyer, (2), ii, 33; Zielinski, *A. Rel.*, viii, 331; Fahz, *ibid.*, xv, 418; Jacoby, *ib.*, xxv, 265, 271; Wiedemann, *ib.*, xxvi, 350.

[6] Bousset, (1), 27. [7] *Panar.*, XXXVII; (1), i, 267. [8] I, xxx.

[9] Origen, *Contra Celsum*, vi, 24–38. [10] *De Princip.*, ii, 11; ANL, x, 152.

[11] Arendzen, CE, vi, 597; Bornkamm, PW, xviii, 654; A. B. Cook, ii, 610; Hilgenfeld, (1), 277–83; T. Hopfner, Das Diagram der Ophiten, in *Charisteria A. Rzach*, Reichenberg, 1930,

the following rearrangement of Origen's text. Celsus said the diagram was composed of seven (ἑπτά for δέκα, ten, in the text) separate (concentric) circles united (surrounded) by another circle representing the soul of the universe and labelled by the Hebrew name of Leviathan (c. 25, perhaps Ouroboros, the serpent with its tail in its mouth). Inside these circles is another circle called Beëmon (Behemoth) in a certain sense the lowest (innermost) (c. 35). The drawing is finally separated into two parts by a thick black line called Geëna (Gehenna), denoting Tartaros (the underworld) (c. 25). Seven angels press from both sides on the soul which separates from the body; one is an angel of light but the others are planetary rulers or archons, and the chief of the archons is called the 'execrable (or accursed) god' (c. 27: λέγεθαι θεὸν κατηραμένον). The first archon has the form of a lion, the second a bull, the third a hideous amphibian, the fourth an eagle, the fifth has the head of a bear, the sixth the head of a dog, and the seventh the head of an ass and is called Thaphabaoth or Onoël (c. 30). Some, said Celsus, add other 'words of the prophets and circle upon circles' (c. 34; see p. 257). Beyond the outer-heavenly upper circle they show certain inscriptions, especially two, viz. the larger and smaller as the Son and the Father (c. 38). The 'execrable god' they call the god of the Jews and of Moses, who rains and lightens, the creator of this visible world (c. 27), and worthy to be execrated, since he cursed the serpent, which gave to the first man knowledge of good and evil (c. 28).

This account is due to Celsus. Origen himself says that in the diagram which he saw, the archons, in the order given, were Michael, Suriel, Raphael (a serpent or dragon), Gabriel, Thauthabaoth, Erathaoth, and Onoël or Tharthabaoth (c. 30); the first was related to the planet Phainon (Kronos, or Saturn) (c. 31); they are the seven planets, in Jewish traditions related to archangels, and Celsus refers to an ascent through the planetary spheres.

There was a square pattern with inscriptions concerning the gates of Paradise, and a flaming circle with a flaming sword as its diameter guarding the tree of knowledge and of life (c. 33).[1] There was a barrier shaped like a hatchet, between a yellow outer and a blue inner circle, and a rhomboid bearing the words 'the foresight of wisdom' (c. 38).

Celsus says names and formulae, or 'salutations', were used by 'those sorcerers' as they pass through what they call the fence of wickedness (φραγμὸς κακίας) or the gate to the realm of each spirit (c. 31), the names of the seven rulers being Ialdabaoth (Saturn, Φαίνων), Iao (Jupiter), Sabaoth (Mars), Adonaios (the Sun, the name has dropped out of Origen's text), Astaphaios (Venus), Ailoaios or Eloaios (Mercury), and Oraios (the Moon). Only Saturn and the Moon (νυκτοφαής) are specified, the other identifications being supplied from the usual old order of their supposed distances from the earth,

86–98; King, (2), 50, 342; Legge, (1), ii, 66; Leisegang, (1), 1941, 168 f., 179 (plate); Lipsius; *Z. wiss. Theol.*, 1864, vii, 35–57; J. Matter, (1), 1828, ii, 184 f., 236 f., 242 f.; iii, 9, plate ID, Salmon, DCB, iv, 84; Thorndike, (1), i, 366. The chapters (c.) in the text refer to Origen's account.

[1] Jung, *Verhl. Naturforsch. Ges. Basel*, 1945, lxvi, II, 411, developed the idea of the 'philosophical tree' in alchemy; *cf.* Philo Judaeus, *De Cherubim*, vii; *Works*, tr. Yonge, 1854, i, 180.

starting with the Moon and ending with Saturn.[1] The names are found in Greek magic papyri and in the Jewish *Qabbalah*.[2]

In order to pass upwards through the planetary spheres the soul must give the 'true name' of each, recite a formula, and show a 'seal' (σφραγίς, an amulet) (c. 32). Celsus (c. 22) had previously described the ascent of the soul through the planetary spheres as symbolised by the 'ladder of Mithra' (see p. 307). Outside, says Celsus, was a circle representing Paradise; beyond this was a blue circle representing darkness and a yellow circle representing light, and a small circle, with gnostic names intersecting them. There is then a circle representing the Son and an outer circle representing the Father (the diagram is perhaps a plane section of concentric spheres). Beëmon (Behemoth) is the atmosphere, Geëna (Gehenna) is a line across the earth, which divides it into the world and underworld.[3]

The fall of the soul is an Orphic doctrine known to Plato.[4] The soul was of celestial origin, a spark of life entering at birth.[5] Its descent from heaven had two aspects: (i) an optimistic, in which it is destined to improve and save men on earth, and (ii) a pessimistic, in which the soul, which had sinned before its fall and had a desire to enter matter, was expelled from heaven.[6] Cicero[7] says the soul descends through the outermost sphere of heaven, then the spheres of the seven planets Saturn, Jupiter, Mars, Sun, Venus, Mercury, and Moon, with the earth in the centre. The commentary by Macrobius (d. A.D. 423)[8] connects this with the mysteries of Mithra (see p. 307). The passage of the soul through the seven planetary spheres is found in the Hermetic *Poimandres*[9] and many other authors[10] and is of Chaldaean-Persian origin.[11] To enable the soul to pass through the Hebdomas (ἑβδομάς) of the seven planetary spheres and reach the celestial region of the Ogdoas (ὀγδοάς), most gnostics believed that help was needed from a divine being who had descended through the Hebdomas for that purpose.[12]

The Peratae (named after a Hebrew word meaning 'crossing over', i.e. the Red Sea), said to be founded by Euphrates,[13] were an Ophite sect who believed that the universe is one, divisible into three, and represented it by a circle enclosed in a triangle: (i) a primary principle, God, like a great spring, (ii) an infinite number of powers, self-generated, (iii) the 'real', the cosmos, which was created. The Logos above draws to himself the spiritual which is in matter 'as naphtha attracts fire from all parts, or better, as the Herakleian stone [the magnet] draws to itself iron but nothing else, or the prickle of the

[1] Bousset, (1), 10; Dieterich, (1), 1910, 45 f., 187; Eisler, (3), 88; Salmon, DCB, iv, 84.
[2] ANL, v, 106; Bousset, (1), 324, 351; *id.*, PW, vii, 1537; Kenyon, 69 (BM Pap. XLVI); Salmon, DCB, iv, 566. On gnostic amulets a lion-headed serpent is Agathodaimon: Budge, (4), 205; Sethe, PW, iii, 2349.
[3] Leisegang, (1), 1941, 111, 168–72, and plates.
[4] Wesendonk, (1), 102. [5] Festugière, (1), iii, 4, 27 f. [6] *Ib.*, iii, 63 f., 83, 91.
[7] *Dream of Scipio*, tr. C. R. Edmonds, 1850, 294; Festugière, (1), ii, 441.
[8] *Commentarii in Somnium Scipionis*, I, xii, 12 f.; ed. Eyssehardt, Leipzig (Teubner), 1893, 531; Whittaker, (2).
[9] i, 25; HT, i, 15.
[10] Hopfner, (1), 265 f.; Lobeck, ii, 737, 933 f.
[11] Bousset, *A. Rel.*, 1901, iv, 136–69; J. Kroll, (1), 206, 298.
[12] Bousset, (1), 320, 351 f.; *id.*, PW, vii, 1507; Salmon, DCB, ii, 850; Scott, ERE, vi, 236.
[13] Hippolytos, iv, 2; v, 12 f.

sea-hawk (κερκὶς θαλασσίου ἱέρακος) attracts gold but nothing else, or as amber attracts chaff, so the serpent draws from the cosmos only that which has become its likeness; it draws back that which it sent out.'[1] There is a male-female power of the invisible waters above called Sea (θάλασσα), enclosed by a dodecahedron from which issue twelve mouths or pipes, through which the world-powers pour hissing.[2] The Peratae used anatomical analogies[3] and seem to have been instructed in science. They were closely related to the Sethians and Naassenes.[4]

The Barbelo-gnostics, an Ophite sect who called the Mother Above Barbelo (Βαρβηλώ, Βαρβηλώθ, βαρβηρώ), had many adherents in wealthy circles in Alexandria, and were mistaken by Celsus[5] for Christians. The origin of the name is doubtful; the Hebrew *brhe bila*, meaning daughter of the Lord is the most probable.[6] Epiphanos[7] describes their obscene rites from his own observation. With the aid of a Barbelo, the *pneuma* in man is separated and restored to its original source.[8]

In the Phoenician cosmogony ascribed to Sanchuniathon (1 cent. A.D.?; see p. 3)[9] two principles, dark air or pneuma (ἀέρα ζοφώδη καὶ πνευματώδη ἢ πνοὴν ἀέρος), and cloudy chaos (χάος θολερὸν ἐρεβῶδες) also called Mōt (μώτ), united and formed all creation. The Ophite Nikolaïtes described by Epiphanios[10] also had two principles: a material σκότος (dark) or βυθός (depth) or ὕδωρ (water), and πνεῦμα, which united and formed Μήτρα [=Mōt], the cosmic matrix, which when fecundated by pneuma formed Aeons. They worshipped Barbelo, residing in the eighth sphere (Ogdoas). Her son Ialdabaoth (Ἰαλδαβαώθ) or Sabaoth (Σαβαώθ), in the seventh sphere, tried to deprive the archons of their vital force, contained in the sperm, and so collect the fragments of the divine substance scattered over the universe.

The Sethians, named after Seth, son of Adam,[11] had three principles: light (φῶς), darkness (σκότος), and pure pneuma (πνεῦμα ἀκέραιον) or subtle breath occupying a place between the other two (like Mithra between Ormuzd and Ahriman).[12] The system, probably derived from the Book of Genesis and Orphic or Stoic doctrines,[13] taught that the lower region is like a matrix filled with black water (ὕδωρ φοβερόν), which boils with waves as the wind blows over it. Between the upper and lower regions is a region of πνεῦμα, from which an aroma or perfume from God descends with light detached from above like a spark, forming πνεῦμα φωτεινόν, which enters the matrix. A winged serpent penetrates into the matrix and creates man, who is saved by

1 Hippolytos, v, 17; (1), 198.
2 *Ib.*, v, 14; (1), 184, the 'fountains of the deep' in Genesis vii, 11; Lipsius, DCB, iv, 714.
3 Hippolytos, v, 17; (1), 198.
4 Dieterich, (1), 78; Schultz, 96.
5 Origen, *Contra Celsum*, vi, 27.
6 Eisler, (1), 187; (3), 140; Hort, DCB, i, 248; Lippmann, (2), ii, 53; Scott-Moncrieff, (1), 156.
7 *Panar.*, XXVI, ii–iv; (1), i, 83C–87D.
8 Aly, HDA, i, 1354; E. Bethe, *Rhein. Mus.*, 1907, lxii, 438 (460); Leisegang, (1), 1941, 187; *id.*, *Pneuma Hagion*, 1922, 71; Del Rio, ii, 15; Vorwahl-Elze, *A. Med.*, 1925, xvii, 201.
9 Rearranged by W. Scott, (1), ii, 112–18; Verbeke, 288.
10 *Panar.*, XXV, v; (1), i, 80.
11 Hippolytos, *Refut.*, v, 19 f.; (1), 198.
12 Bousset, (1), 119 f.; Leisegang, (1), 1941, 151 f.; Schultz, 108.
13 Dieterich, (1), 1891, 59; Verbeke, 293.

drinking the water of life (ζῶντος ὕδατος). The Sethians taught a doctrine of conflation and mixtion (περὶ κράσεως καὶ μίξεως λόγον) that the material world is an 'unnatural' mixture which can only be put right by separating its parts. They give several analogies for this mixture and separation: incense composed of various parts gives one smell, recognised by experts as composed of several smells; metals can be mixed or alloyed together, as gold, silver, or tin with copper, but can be separated by art; or wine can be mixed with water. The separation depends on specific attractions, as the Herakleian stone (the magnet) attracts iron, amber chaff, and the spine of the sea-hawk (κέντρον τοῦ θαλασσίου ἱέρακος) gold.[1] These examples are taken from Aristotle, except the last, which occurs nowhere else.

Basileides

Basileides (*c.* A.D. 125), at first a Christian, went to Alexandria from Antioch, and interpreted the gospels in the light of Platonic and Pythagorean philosophy.[2] The main accounts of Basileides are in Irenaeus,[3] Hippolytos,[4] and Epiphanios.[5] Agrippa Castor, quoted by Eusebios,[6] says Basileides had 24 books and invented the non-existent prophets Barkabbas and Barkoph. His followers, like the Pythagoreans, took a vow of silence for five years. The 24 books are probably the *Exegetica* quoted by Clement of Alexandria and the 'treatises' (*tractatuum*) cited in the *Acta Archelai*; others say that Basileides wrote an apocryphal gospel himself, although no trace of this exists.[7] The large work of Basileides was read by Clement,[8] who (like Hippolytos) says the Basileidians divided the universe into stages (διαστηματα). They referred to the passions as appendages (προσαρτήματα), spirits which have a substantial existence (κατ' οὐσίαν ὑπάρχειν) attached to the rational soul in a certain primitive turmoil and confusion. Other bastard and alien natures of spirits with animal characteristics (ἰδιωματα), grow from these appendages and become perceptible in the region of the soul. There are also characteristics of plants and even stones, e.g. the hardness of diamond. Plutarch[9] ridiculed a Stoic doctrine (perhaps of Chrysippos) that living animals (ζῷα) were crowded round the central point of the heart where the ruling principle (τὸ ἡγεμονικόν) is located, as in a sort of Trojan horse. The *Acta Archelai* in which it says that Basileides took as first principles light and darkness, which became mixed,

[1] Hippolytos, v, 21; (1), 212.

[2] Amélineau, 77–152; Bousset, (1), 92; Dodd, (2), 99; Hort, DCB, i, 268; J. L. Jacobi, *Basilidis Philosophi Gnostici Sententias ex Hippolyti . . . nuper reperto illustravit*, 1852 (38 pp.); King, (2), 81; Leisegang, (1), 1941, 196; E. Meyer, (2), iii, 625, 631; A. S. Peake, ERE, ii, 426–33; Schultz, 139 153; Ueberweg, (1), ii, 36; G. Uhlhorn, *Das Basilidianische System, mit besonderer Rüchsicht auf die Angaben des Hippolytus*, Göttingen, 1855 (68 pp.); Verbeke, 296; *Basilides VII Sermones ad Mortuas. The Seven Sermons to the Dead*, Edinburgh, 1925 (privately printed, 28 pp.).

[3] I, xxiv, 1, 3–7; II, xiii, 8; xvi, 2; xxi, 1; xxxv, 1.

[4] *Refut.*, vii, 1–27.

[5] *Panar.*, XXIII, i; XXIV; (1), i, 62B, 68–76.

[6] *Hist. Eccles.*, iv, 7; ed. Dindorf, Leipzig, 1867, 141 f.

[7] Hort, DCB, i, 269.

[8] *Strom.*, II, xx, 112–13, p. 488P; VII, ii, 12, p. 835P; Eisler, (3), 63, 84 f.; Hort, DCB, iv, 271.

[9] *De communibus notitiis*, xlv; *Moralia*, ed. Dübner, Paris, 1841, ii, 1326; Hort, DCB, i, 275; J. Matter, (1), 1828, ii, 77.

[10] *Hegemonius Acta Archelai*, ed. C. H. Belson, GCS, 1906, 61, 96–8; Migne, PG, 1857, vii, 1263; Völker, 1932, 38.

darkness swallowing a *reflection* of light as from a mirror. The good spirit, light, attempted to separate the light swallowed by darkness. The world contains this small portion of light.

Irenaeus says Basileides taught that from an Unknown Father proceeded mind (νοῦς), reason (λόγος), prudence (φρόνησις), wisdom (σοφία) and power (δύναμις), and from these principalities, powers, and angels. The angels made in succession 365 heavens, the number of days in the year, their chief being the God of the Jews, whom they call Abrasax (*Αβρασάξ*), who has in himself the 365 numbers. They distributed the heavens according to mathematical theorems. Epiphanios[1] says that each of the 365 heavens had its own archon; the present world is the work of the last archon and is a hysterēma (ὑστέρημα) or 'defect' (a Valentinian term).

Hippolytos says that Basileides taught that the beginning of things was pure nothing, not even 'nothing'. Then the 'not-being god (οὐκ ὢν θεός, without the definite article)' willed to make a not-being world out of not-being things, and produced (how is not explained) 'a single seed containing the seed-mass of the universe (καταβαλόμενος καὶ ὑποστησας σπέρμα τι ἓν ἔχον πᾶσαν ἐν ἑαυτῷ τὴν τοῦ κόσμου πανσπερμίαν)'. This was not a material emanation (προβολή) but it came forth out of nothing like a voice, 'but the speaker was not, and that which came into being was not.' This contained the seeds of all future forms and existences, as the mustard-seed contains the leaves and branches of the tree, or the peacock's egg the brilliant colours of the full-grown bird. It had within itself the three-fold sonship, in all things consubstantial (ὁμοούσιος) with the not-being god. Part of the sonship was subtle (λεπτομερές), part coarse (παχυμερές), and part in need of purification (ἀποκαθάρσεως δεόμενον). The first at once burst out (διέσφυξεν) and mounted 'like a wing or a thought' to the not-being god; the second borrowed a wing from the Holy Spirit (πνεῦμα ἅγιον) but could not rise completely to the not-being god, since the Holy Spirit was not consubstantial with it; the Holy Spirit remained as a boundary spirit (μεθόριον πνεῦμα), a firmament dividing the cosmic from the hypercosmic, and emitting downwards a fragrance of the sonship like a vessel which once contained ointment.[2] The third sonship remained in the seed-mass. But from this burst forth the great archon Abrasax, a beauty, greatness, and power which cannot be uttered, named after the 365 heavens. He raised himself up to the firmament, which (till he became wiser) he supposed was the upper limit of the universe. He was better than all cosmical things except the sonship left below, which he did not know was better than himself. Abrasax then created from the things below a son better than himself, the Ogdoas, and set him on his right hand. Another archon, inferior to the first, rose from the seed-mass, made a son wiser than himself, and created the aerial world, the Hebdomas.

The seed-mass[3] is our world, in which the plan (λογισμός) of the not-being

[1] *Panar.*, XXIV; (1), i, 68 f., 74.

[2] The 'boundary spirit' in Philo Judaeus is the Logos, the 'winged soul' of Plato, and the 'pure pneuma (πνεῦμα ἀκέραιον)' of the Sethians Verbeke, 296.

[3] The πανσπερμία of Anaxagoras and its 'separation'

god is realised. The third sonship left in it was unknown until, from below, the powers penetrated (διήκουσιν) upwards (through the stages) and so thoughts (νοήματα) were caught from above as Indian naphtha inflames from a distance without contact; thus the power in the Holy Spirit conveyed the thoughts of the sonship as they flowed and drifted (ῥέοντα καὶ φερόμενα) to the son of the Great Archon, who now learned from him that he was not the not-being God, but had himself come into being. Hippolytos[1] says Basileides spoke of a division of the cosmos into stages (διαστήματα), which was a technical term,[2] also used by Clement of Alexandria.[3]

The formlessness of our world was then enlightened, and the hidden mystery revealed to the third sonship in it, by light coming from the Hebdomas upon Jesus, son of Mary. The third sonship, being purified and made subtle, followed Jesus and ascended, and every part of the sonship (i.e. from individuals) reached above the limiting spirit god. Then God brought to the world great ignorance (ἄγνοια) so that it does not strive to what is above; even the archons of the Hebdomas and Ogdoas remained in peace, and thus there was a restoration (ἀποκατάστασις), as fore-ordained (προλελογισμένος) in the great heap.

Hippolytos says: 'their whole theory is of a mixture, which they represent in the seed-mass (ὅλη γὰρ αὐτῶν ἡ ὑπόθεσις σύγχυσις οἱονεὶ πανσπερμίας), and a separation according to kinds and a resolution of the mixture into its component parts (ἀποκατάστασις τῶν συγκεχυμένων εἰς τὰ οἰκεῖα).'[4] There is no evil principle and (as Peake says) the outlook is kindly. Hippolytos tried to show that Basileides borrowed from Aristotle, but he was probably mainly influenced by Stoicism; his system as reported by Hippolytos is essentially Greek.[5]

The origin of the name Abrasax (or Abraxas)[6] as given by Irenaeus[7] that it is a representation in letters of the number 365 (αβρασαξ $=1+2+100+1+200+1+60=365$) is most probably correct.

St. Jerome mentioned that the numerical sum 365 is the same as that in μειθρας ($40+5+10+9+100+1+200$), and Hopfner[8] and Leisegang[9] think the meaning is Mithras, the sun-god: ψ-Clement[10] says the wandering sun was called Mithras 'as completing the period of a year' (365 days). Heliodoros[11] said the name Neilos (Νειλος $=50+5+10+30+70+200=365$) has the same value. Irenaeus[12] says the Basilidians 'strove to set forth the names, principles, angels, and powers of the 365 heavens', and Epiphanios[13] that they reckoned 365 parts (μέλη) in the human body (a correlation of the macrocosm and microcosm).[14] Other explanations of the origin of Abraxas[15] are less probable. The name occurs (usually as αβρασαξ) on amulets (so-called 'gnostic gems'), often combined with Ιαω and Σαβαωθ, and in magic papyri,[16] and

[1] *Refut.*, vii, 24; (1), 368. [2] Hort, DCB, i, 271, 274. [3] *Strom.*, VII, ii, 12.
[4] Leisegang, (1), 228–34 (the part 235 f. seems to me doubtful).
[5] Hort, DCB, i, 271; Peake, ERE, ii, 432.
[6] Beausobre, 1739, ii, 1–68 (Basileides), 50 f.; Hort, DCB, i, 9, 279; N. Lardner, *The Historie of Heretics*, 1780, xiv–xxviii, pp. 98–118; J. Matter, (1), 1828, ii, 46 f. (52–3, giving 23 +4 authors who had written on it).
[7] I, xxiii. [8] PW, xiv, 317. [9] (1), 1941, 249.
[10] *Homil.*, vi, 10. [11] *Aithiopika*, ch. ix. [12] I, xiv, 5.
[13] XXIV, vii; (1), i, 73. [14] J. Matter, 1828, (1), ii, 77.
[15] Budge, (4), 208; (6), 332; Dornseiff, 42; Hort, DCB, i, 9; S. Sharpe, *Egyptian Mythology and Egyptian Christianity*, 1863, 63.
[16] Jacob, HDA, i, 99.

was used because it sounded mysterious.[1] The 'Abraxas gems' are amulets and have no connection with Basilides; 73 collected by Paul Praun of Nurnberg (1548–1616) are in the British Museum.[2] The god Abrasax or Abraxas is represented on them with the head of the cock (a solar bird), the body of a man holding a whip and a shield, and legs of serpents.[3] The sign SSS which also occurs on gnostic amulets[4] has been supposed to stand for Asklepios, Chnubis, or the Sumerian god of healing Ningishida, all associated with serpents. Alexander of Tralles[5] mentions the suspension of an amulet for 360 days.

Basileides' son, Isidoros, is mentioned by Hippolytos.[6] Clement of Alexandria[7] gives three extracts from his *Exegetica*, claiming that Greek philosophy was borrowed from the Jews, an example being Pherekydes following the 'prophecy of Ham (*Χάμ*)'. Clement[8] also quotes from his treatise *On the Adherent Soul* (*Περὶ προσφυοῦς ψυχῆς*) saying that the soul is a unity (*μονομερής*), and that it is our duty to overcome the inferior creation within us (*τῆς ἐλάττονος ἐν ἡμῖν κτίσεως*) through the reasoning faculty (*τῷ λογιστικῷ*); Clement also[9] quotes from the *Ethics*. Epiphanios[10] says that in his time (*c.* A.D. 375) there were Basileidians in Alexandria and in four other places in the western Delta.

VALENTINUS

Valentinus (*Οὐαλεντῖνος*), in Hadrian's time (A.D. 117–138), is said by Epiphanios to have been born on the coast in Egypt and educated in Alexandria. He visited Cyprus, was in Rome about 136–165, and was at first an orthodox Christian. Accounts of the teachings of Valentinus and of his school, the Valentinians, are difficult to separate.[11] The accounts in Irenaeus and Hippolytos[12] differ, and another account is in the *Excerpts from Theodotos* (*ἐκ τῶν Θεοδότου*) in 86 fragments at the end of the *Stromateis* of Clement of Alexandria in an 11-cent. Laurentian codex, probably notes used by Clement. Theodotos is otherwise unknown but probably wrote about A.D. 160–70.[13]

[1] Dieterich, (1), 154.
[2] Beausobre, ii, 50 f., 57 f., 61 f.; J. Matter, 1828, iii (plates); Bucher, 321 f., plate 1; Budge, (4); King, (2); Lardner, *op. cit.*; J. J. Bellermann, *Drei Programmen über die Abraxas-Gemmen*, 1820; J. Macarius [l'Heureux] and J. Chiflet, *Abraxas, sev Apistopistvs; quæ est Antiqvaria de Gemmis Basilidianis Disquisitio. Accedit Abraxas Protevs, sev multiformis Gemmæ Basilidianae Portentosa Varietas*, 4°, Antwerp, Plantin, 1657 (28 plates); Salmasius, (4), 566 f.
[3] King, (2), 246, figs. 2, 4, 9, 14 in plates A, B; Riess, PW, i, 109; Sethe, PW, iii, 234.
[4] Budge, (4), 205, 458, 488; (6), 332; A. B. Cook, ii, 1084; U. F. Kopp, iii, 341.
[5] *De Arte Medica*, xi; *Med. Art. Princ.*, i, 314D.
[6] *Refut.*, vii, 20; (1), 356.
[7] *Strom.*, VI, viii, 53, p. 767P.
[8] *Strom.*, II, xx, 113–14, p. 488P.
[9] *Strom.*, III, i, 2, p. 510P.
[10] *Panar.*, XXIV; (1), i, 68C.
[11] Irenaeus, I, i, xi; III, iv, 3; Hippolytos, *Refut.*, vi, 21–37; (1), 258–292; Epiphanios, *Panar.*, XXXI, xxxvi; (1), i, 163–204.
[12] Given in parallel columns by Sagnard, (1), 145–98, 224 f., 234 f. See Amélineau, 166–320; Dodd, (2), 100, 105–7; G. Heinrici, *Die Valentinianische Gnosis und die heilige Schrift*, 1851; Hilgenfeld, (1), 461; *id.*, *Z. wiss Theol.*, 1880, xxiii, 280; 1883, xxvi, 356; Leisegang, (1), 1941, 281 f.; *id.*, PW, II Reihe, xiv, 2261; Lipsius, DCB, iv, 1076; K. Müller, *Gött. Nachr.*, *phil.-hist. Kl.*, 1920, 179–242; Schultz, 164; Scott, ERE, xii, 572; Tondelli, 32 f., 57, 88; Völker, 57 f., 93 f.
[13] *Excerpta*, Greek, and Latin tr. of Combefis, in Fabricius, (1), (*a*) 1712, v, 134–84; text in Stählin, *Clemens Alexandrinus*, GCS, 1909, xvii, 105 f.; in Völker, 123; R. P. Casey, *The Excerpta ex Theodoto of Clement of Alexandria*, London (printed U.S.A.), 1934; Sagnard, *Clément d'Alexandrie Extraits de Théodote*, 1948 (Stählin's text, tr., and notes); see Buonaiuti, 8, 97; Lipsius, DCB, iv, 1076; Sagnard, (1), 521 f.

Hippolytos[1] gives two branches of Valentinians, the Eastern (Anatolian) in Egypt and Syria, and the Western (Italian) in Rome, Italy, and Gaul, and their doctrines differed. There has been much discussion as to the sources used by Irenaeus and Hippolytos. W. Foerster[2] supposed that Ptolemaios and Herakleion (see below) were the main sources for Hippolytos; Sagnard[3] Ptolemaios or his school for Irenaeus. There is a fragment on emanations in Epiphanios,[4] and another in Clement.[5] Tertullian's *Adversus Valentinianos* (*c.* A.D. 200–7, or later) is neglected by Sagnard.[6]

The Valentinians regarded the visible world (*κόσμος*) as an imperfect image made by the Demiurge of the suprasensible world, a copy of the living Aeon (*τοῦ ζῶντος αἰῶνος*).[7] Man is an image of a pre-existent man (*ἄνθρωπος προών*). The angels who made Adam after the image of Man were afraid of their work and quickly hid it.[8] Man, at first given everlasting life, chose death to overcome death, since by his death, death died in him.[9] The nature of God is inexpressible but is called Proarché (*Προαρχή*), Propator (*Προπάτωρ*) or Bythos (*Βυθός*).[10] The divine nature is double, male-female (*ἀρσενόθηλυς*), in unity, and the law of couples or *szyiges* (*συζυγιαί*), based on sexual generation, runs through Valentinus's teaching.[11] Bythos and Sige (*Σιγή*, Silence) first produce eight couples, and so on to a series of thirty aeons (*αἰῶνες*) forming a Pleroma (*Πλήρωμα*),[12] the last being Sophia (*Σοφία*, Wisdom), or Achamoth (*'Αχαμώθ*),[13] who fell from the Pleroma and, remembering a better world, gave birth to Christ 'with a shadow (*μετὰ σκιᾶς τινος*)'. He cut away the shadow and rose to the Pleroma, of which he was the image (*εἰκονα*), leaving his mother with the shadow and deprived of pneuma; she then gave birth to the Demiurge (*Παντοκράτωρ*), also called Topos (*Τόπος*), and a left-hand archon (*Κοσμοκράτωρ*). The Demiurge, borrowed from Plato (see p. 256), replaces Ialdabaoth in the Ophite systems.[14]

The Demiurge created a material, hylic, or terrestrial man, not from dry earth but from an invisible fluid substance or flux of matter (*ῥευστοῦ τῆς ὕλης*), and breathed into its body the psychic man (*τὸν ψυχικὸν*), 'made after his image and resemblance'. After this creation of the psychic man, Sophia (or the Logos) infused into it, unknown to the Demiurge, a masculine seed (*σπέρμα ἀρρενικον*), which 'leavens throughout (*ἐζύμωσεν*)', and produced a pneumatic man (*πνευματικὸς ἄνθρωπος*), thus uniting the material body and the soul.

The 'complete' man is composed of four elements: (i) the hylic (*χοϊκος*) or animal soul (*ψυχὴν ὑλικήν*), consubstantial (*ὁμοούσιον*) with that of wild animals; (ii) the psychic (*ψυχικός*) soul, breathed or 'sown' in the hylic man by the breath of the Demiurge and consubstantial with him, giving the man

[1] *Refut.*, vi, 35; (1), 286.
[2] Von Valentin zu Heraclion, *Z. neutest. Wiss.*, Giessen, 1928; Beih. vii, no. 3.
[3] (1), 1947, 220 f. (says Foerster neglected Clement of Alexandria).
[4] *Panar.*, XXXI, v; (1), i, 168.
[5] *Strom.*, VII, xvii.
[6] Tondelli, 34.
[7] Clement, *Strom.*, IV, xiii.
[8] *Ib.*, II, viii; an Ophite idea.
[9] *Ib.*, IV, xiii; a modern evolutionary theory: Lecomte Du Noüy, *Human Destiny*, 1951, 62.
[10] *βάθος* in the *Excerpt. Theod.*, § 29.
[11] Tondelli, 37.
[12] A Valentinian technical name: Sagnard, (1), 295, 334.
[13] Leisegang, PW, II Reihe, iii, 1019.
[14] Salmon, DCB, i, 804.

of resemblance (καθ' ὁμοίωσιν), reasonable and divine (ἡ λογικὴ καὶ οὐρανία ψυχή); (iii) the pneumatic nature (πνευματικός φύσις), filling the psychic soul (ii) as marrow fills a bone; and (iv) a 'tunic of skins (δερματίνους χιτῶνας)' surrounding the whole.[1] The formation (πλάσμα) made by Sophia is Adam, created in the name of the pre-existent man, but a higher power implanted in him the seed of a divine spiritual essence (σπέρμα τῆς ἄνωθεν οὐσίας), a pneumatic seed (πνεῦμα διαφέρον) which remains in the world as a race capable by its nature of being saved.[2]

Things made by an imperfect creator are like a spot at the centre of a circle,[3] isolated from God by concentric circles.[4] Between the first pair, Abyss and Silence, and the remaining parts of the first Ogdoas, is the Limit (Ὅρος) also called Σταυρός (the Cross).[5] Every separate man is born in one of the three natures and cannot help himself. Only the gnostics are pneumatic and they need not trouble about their way of life; they are like gold, untarnished in mud (χρυσὸς ἐν βορβόρῳ κατατεθείς);[6] they are saved in any case by reason of their spiritual nature (διὰ τὸ φύσει πνευματικοὺς εἶναι), and no material work (ἐν ὁποίαις ὑλικαῖς) can deprive them of this. In the final consummation (τὴν δὲ συντέλειαν), achieved by gnosis, the pneumatic element is made perfect, all that is merely material is burnt up, and the purified soul rises to the highest position below the Pleroma, where the gnostics leave their ψυχαί, enter the Pleroma as pure spirit (πνεῦμα), and enjoy bridal union (νύμφωνα, θάλαμος) with the angels dwelling in it, a 'pneumatic marriage' (πνευματικὸς γάμος)[7] like that described in the *Acts of Thomas*.[8]

The Italian school said the Saviour had a psychic body (ψυχικόν σῶμα), the Eastern school that he had a spiritual body (πνευματικόν σῶμα); he had no material body (σάρξ, or τό σαρκίον), since matter is incapable of salvation (δεκτικὴν σωτηρίας); in the Virgin birth he passed like water through a tube (ὕδωρ δὶα σωλῆνος) (the Docetic heresy). The pneumatic or excellent (διαφέρον) 'seed' of man must descend into terrestrial putrefiable matter in order to develop, to 'form' itself, and to come to perfection; this is an alchemical idea.[9] The fall of Sophia is based on the Greek Orphic σῶμα-σῆμα idea, a 'better part' being imprisoned in matter.[10]

All things are 'hanging (κρεμάμενα)' and 'upborne (ὀχούμενα)', flesh hanging on the soul, the soul upborne by air, air hanging on ether, fruits on Bythos, and the child in the matrix; the universe is a great scale of being (a Platonic idea);[11] this has some analogy with the alchemical ***kerotakis*** apparatus and the picture is like that of Basileides (see p. 260).

The *Excerpts from Theodotos* say that the stars and powers are not equal; some are benevolent and others malevolent, some are on the right and others are placed on the left; they indicate, but do not determine, the influences of

[1] Sagnard, (1), 528 f.; *id.*, 1928, 63 f.; Tondelli, 41.
[2] Lipsius, DCB, iv, 1086, 1088.
[3] Irenaeus, II, iv, 2; II, xxxi, 1.
[4] Sagnard, (1), 106.
[5] Sagnard, (1), 247 f., 302; Tondelli, 38, 57.
[6] Irenaeus, I, vi, 2.
[7] Irenaeus, I, vii, 1; Anrich, 81; Bousset, (1), 69 f., 315 f.; Duchesne, i, 124; Sagnard, (1), 104, 402–4, 413.
[8] Schultz, 217 f.
[9] Sagnard, (1), 182–8, 238, 390, 396, 399, 402, 410, 413–14; *id.*, (2), § 6, p. 53.
[10] *Id.*, (1), 249.
[11] Hippolytos, *Refut.*, vi, 37; (1), 290 (from a hymn).

the dominant (planetary) powers. When the Saviour came to intervene in the struggle of the cosmic elements (στοιχεῖα), a new and strange star arose which broke the enchantment of the old astral positions (ἀστροθεσίαν), and, shining with a new light very different from the cosmic light, pointed out the way of salvation.[1]

The idea of the evil influence of the planets had receded among the Valentinians, who affirmed that 'these seven heavens are intelligent, spoke of them as angels . . . and declared that Paradise, situated above the third heaven, is a powerful angel'.[2] There is a difference between the Greek view that the universe is one although the circles of the planets are seven, and the Jewish-Christian notion of a plurality of heavens, that of seven planetary 'heavens' being a heresy.[3]

From below the throne of Topos a stream of fire (ποταμός πυρός) flows into the vacuum (ῥεῖ εἰς τὸν κενὸν), which never becomes full.[4] A passage:[5] καὶ τὸ σωματικὸν πνεῦμα τοῦ αἰσθητοῦ πυρὸς τροφὴ καὶ ὑπέκκαυμα γίνεται, ὀλίγον ὄν· πλεῖον δὲ γενόμενον σβεστήριον πέφυκεν:[6] 'when the material wind (πνεῦμα σωματικόν) is gentle it is the food and substrate of fire, but when it increases in force it extinguishes it', is based on Hippokrates (see p. 31) and Hoefer's[7] identification of πνεῦμα σωματικόν, 'esprit matériel', with oxygen is wrong. Earlier in the passage it is said that 'fire is in one part material (σωματικόν) and attacks all bodies, and in another part pure and immaterial (καθαρὸν καὶ ἀσώματον) and attacks immaterial beings (ἀσωμάτων) such as demons, evil angels, and the Devil'. These are Stoic ideas (see p. 152).

The sources of the Valentinian system are diverse. Egyptian[8] origins are doubtful.[9] Iranian sources,[10] concerning the terminology σῶμα = κόσμος, and the ascent of the 'completed' gnostic on the dissolution of the kosmos, are uncertain. The Fourth Gospel was known in Egypt and Valentinus may have derived his idea of the Logos from it.[11] Sagnard[12] recognises six sources: (i) Plato's *Timaios*, perhaps by way of the Stoicised *De Dogmate Platonis* and Plutarch (for example, ideas such as living beings are formed from mixtures, the Demiurge, the three natures); (ii) Stoic (cosmic biology, σῶμα-σῆμα; distinction between substance (οὐσία) and matter (ὕλη or *silva*); principles (ἀρχαί) distinguished from elements (στοιχεῖα); pneuma = soul = logos, with a force, τόνος, producing expansion and contraction; ascent and descent (ἄνω-κάτω) of the soul); (iii) mystery religions (revelation, Sophia, 2 cent.); (iv) *Hermetic Books* (double character of man, descent and ascent, revelation, absorption in Nous);[13] (v) Jewish (Sophia-Achamoth, Chochoma in the *Wisdom of*

[1] Sagnard, (2), 193 f.
[2] Irenaeus, I, v, 2; Epiphanios, XXXI, xviii; (1), i, 186 AB.
[3] Thorndike, (1), i, 488.
[4] *Excerpta*, ed. Stählin, 118 f.; Sagnard, (2), 141; based on Daniel, vii, 9; E. Meyer, (2), ii, 199.
[5] *Excerpta*, § 81; Sagnard, (2), 204.
[6] Translated by Combefis, Fabricius, (1) (*a*), v, 177: item spiritus (ventus) cum modicus est, ignis sensibilis cibus est ac fomes; si autem vehementius flaverit, vim extinguendi habet.
[7] (1), i, 181–2.
[8] Amélineau, 261, 281, 326; Bousset, (1), 106 (restricted); King, (2), 95 f.; Legge, (2), ii, 17; Scott, ERE, vi, 234.
[9] Scott-Moncrieff, (1), 5, 176.
[10] Reitzenstein, (5), 135.
[11] Tondelli, 51, 55.
[12] (1), 220 f., 564 f., 609 f.
[13] Amélineau, 298; Bousset, PW, vii, 1508; Dodd, (1), 129 f., 207 (but *Poimandres*, c. A.D. 300, would be too late to influence Valentinus).

Solomon, 1 cent.; wisdom=divine pneuma; Philo's Logos in the aspects of divine pneuma; divine man composed of pneuma); (vi) Christian (Father of all the aeons, quotations of Scripture, relations with St. Paul). All these combined under the influence of Alexandrian syncretism, although some are incompatible. The mythological personages of older gnosis are replaced by Hellenistic abstract beings which personify the different stages of a process in which the One communicates and reveals itself to derived existences.[1] It is possible, as Irenaeus[2] hinted, that the complicated series of emanations is based on Hesiod's genealogies of the gods.

A relation between gnosticism and early Greek alchemy, especially Zosimos (A.D. 250–300),[3] is apparent. The alchemists said: 'nothing is achieved unless the incorporeal are made corporeal and body is made incorporeal.'[4] The epithet 'boiling' (ἐκβεβράσθαι, ὑπερβλύσαι, etc.) given to Sophia[5] suggests distillation, separating the pure and impure; ἐξεβρασθῃς (from ἐκβράσσω or ἐκβράζω, to throw out an effervescence) also occurs in a Leyden magic papyrus.[6] Spirit (τό πνεῦμα) is a product of sublimation, and τό πᾶν is a preparation.[7] Sublimation and distillation are called ἄνω καὶ κάτω,[8] as the Demiurge made what is light, tending upward, and what is heavy, tending downward (κούφων καὶ βαρέων, ἀνωφερῶν καὶ κατωφερῶν),[9] 'separated two mixed substances (διακρίναντα τὰς δύο οὐσίας συγκεχυμένας), and made bodily the incorporeal (ἐξ ασωμάτων σωματοποιήσαντα), separating the pure (τό εἰλικρινές) from the heavy (τὸ ἐμβριθές), muddy (τό θολερόν), and viscous (τὸ παχυμερές),[10] suggesting refining, filtering, and purifying. The quotation in the *Excerpta Valentinus* of Genesis i, 2, in the form that 'the Spirit of God is borne on the waters by its πνεῦμα', suggests distillation, as also the epithet ἐπιφέρεσθαι applied to the pure, and ὑποφέρεσθαι to the hylic, corresponding with the ἀνωφερῶν and ατωφερῶνκ (sursum advolantium et deorsum devergentium) of Irenaeus. The seed of gnosis in Irenaeus is an embryonic germ, together with its growth.[11] There is some relation between 'salvation' sought by gnosis and 'transmutation' in alchemy,[12] but the analogy should not be pressed too far.

Ptolemaios

Ptolemaios, a disciple of Valentinus of uncertain date, regarded the aeons as independent personal subsistences outside god, whilst Valentinus made them mere affections of the deity.[13] A *Letter of Ptolemaios to Flora*, his gnostic 'sister',[14] explains that the Saviour transforms the sensible and apparent into the spiritual and invisible (ὃ μετέθηκεν . . . ἀπὸ αἰσθητοῦ καὶ φαινομένου

[1] Salmon, DCB, ii, 682.
[2] II, xiv, 5.
[3] Berthelot, (1), 34, 57, 182; Festugière, (1), i, 240 f.; Sagnard, (1), 243 f.
[4] Berthelot, (2), ii, 115: Hermes.
[5] Sagnard, (1), 315, *n*. 1.
[6] Reuvens, (1), 1^e Lettre, 39, Addit. et Corr. 161.
[7] Sagnard, (1), 243–4, 396.
[8] Lippmann, (2), i, 682 (index).
[9] Irenaeus, iv, 5; v, 1, 2; Sagnard, (1), 243.
[10] *Excerpt. Theodot.*, 46–7.
[11] Sagnard, (1), 244, 401.
[12] *Ib.*, 614.
[13] Lipsius, DCB, iv, 515.
[14] Epiphanios, XXXII, i–xii; (1), i, 214–18; Leisegang, (1), 1941, 298–308; Migne, PG, 1857, vii, 1281; ed. Holl, 1915, i, 450–64; Sagnard, (1), 439, 452 f., 460, 473, 477; Tondelli, 62; Völker, 1932, 87.

ἐπὶ τὸ πνευματικὸν καὶ ἀόρατον). The good earth (καλή γῆ καὶ ἀγαθή) and the seeds (σπερμάτων) bring forth the fruit (τὸν καρπὸν), is a Valentinian simile. Matter is synonymous with evil. Ptolemaios promised to reveal the esoteric doctrine in another letter or verbally; what it was we do not know.

Irenaeus[1] says some gnostics taught that from the suffering (πάθη) of Achamoth proceeded the moist part of matter, from her smile the bright part, from her sadness the solid, and from her fear the moveable, and these are the four elements. Irenaeus and the *Excerpta* (§ 48) of Theodotos (perhaps from Ptolemaios) make the rooted fear (στάσις ἐκπλήξεως) of Sophia produce earth; tears or motion of terror (κίνησις τοῦ φόβου) produces water; frozen pain (λύπης πῆξις) produces air; ignorance (ἄγνοια) of the other three gives fire, which penetrates them.[2] An Rgyptian magic papyrus says the tears of Horus form fragrant plants, those of other gods form trees, flowers, bees, salt, etc.[3]

Markos

The most interesting gnostic from our point of view is Markos (*c.* A.D. 150), a Valentinian, either (as St. Jerome says) an Egyptian or a Palestinian Jew, called by Hippolytos 'a master of magic'; Irenaeus says he 'joined the buffooneries of Anaxilaos with the craftiness of the Magi' and pretended to work miracles. The mention of Anaxilaos (see p. 219) and the fondness of Markos for number mysticism suggest that he was a Neopythagorean (as Hippolytos says).[4] He gave the names of the aeons their numerical values in the Greek alphabet, deriving other numbers by spelling out the names of the letters (e.g. $\delta=\delta+\epsilon+\lambda+\tau+\alpha$) and also studied astrology. He used the name element (στοιχεῖον) in the technical sense of aeon, and said the seven vowels were emanations of Man (the voice). His number mysticism is ingenious and seems to have been given in a lecture; it includes the representation of a cosmic woman, Aletheia, by letters of the alphabet arranged in two columns (α to μ down, ν to ω up), so that the head is $\alpha\omega$, the feet $\mu\nu$, etc., exactly like the cosmic man of the later *Qabbalah* (see p. 347), which was probably copied from it. Hippolytos refers to these as 'bits and pieces of Pythagorean philosophy'; Pythagoras touched on magic and based physiognomy on numbers and measures,[5] and Egyptian theology and medicine were both based on numbers.[6] Markos said that the four elements were formed from the primary tetrad, and with their four qualities form the image of the Ogdoas ($4+4=8$).

The significance of the number four also occurs in magic papyri; the 'four bases' occur in Egyptian sources which represent the world by a circular snake divided into four by a cross.[7] The seven planets, with the sphere

[1] I, v, 4; cf. I, ii, 3, I, iv, 2; II, x, 3.
[2] Bousset, (1), 234; de Faye, 108, 113, 123.
[3] Amélineau, 304.
[4] Irenaeus, I, xiii–xxi (ed. Harvey); II, xxiv, 1–4; Hippolytos, vi, 39–55; (1), 296–344; Epiphanios, *Panar.*, xxxiv; (1), i, 232; Berthelot, (1), 34, 57, 64, 182; *id.*, (3), 17; Dornseiff, 19, 35, 128; de Faye, (1), 339; Fendt, 38; Hilgenfeld, (1), 369; King, (2), 286, 369; Legge, (2), ii 40; Leisegang, (1), 1941, 326; J. Matter, (1), 1928, ii, 165 f.; Renan, (1), vii, 127; Sagnard, (1), 337 f., 358 f., 429 f.; Salmon, DCB, ii, 161; iii, 827; Schmitz, 189.
[5] *Ref.*, i, 2; (1), 10.
[6] *Ib.*, iv, 43–4; (1), 108–12.
[7] Reuvens, (1), 1e Lettre, 34 f., Appendix, 150; Addit. et corr., 160; Salmon, DCB, ii, 148.

containing them (or the eighth heaven), according to Markos, make an ogdoas and on adding the Sun and Moon compose a decad; types of an invisible decad proceed from the Logos. His followers repeated Hebrew words, had a ritual of 'spiritual marriage', provided pass-words and magic formulae for use in ascending through the planetary spheres, and spoke of throwing off the bonds of the soul (ῥίψαντα τὸν δεσμὸν αὐτοῦ, τουτέστι τὴν ψυχήν).

Markos seems to have studied chemistry and had a good knowledge of drugs, compounding and selling love-philtres to women, who were particularly prominent in his congregations, which included Christians, whom he taught to prophesy and led astray; he claimed to have received direct inspiration, and belonged to the same group of impostors as Simon Magus and Alexander of Abonoteichos (see p. 277).

Irenaeus[1] and Hippolytos[2] say that the followers of Markos had a special baptism called 'redemption (ἀπολύτρωσις)', in which they uttered magic formulae. In performing the sacrament he pretended to change white wine in a glass into blood (no doubt by adding iron vitriol, which reacted with the tannin in the wine); and formed a purple red liquid (πορφύρεα καὶ ἐρυθρα ἀναφαίνεσθαι ποιεῖ), because the great Charis (a Valentinian consort of Bythos, and a technical word in Ophite prayers) had dropped some of her blood in it. Epiphanios[3] said he poured white wine into three cups, when it became blood-red, purple, and blue liquids, uttering an incantation, which Epiphanios said really caused the effect, whilst Hippolytos says it was produced partly by demons and partly by sleight-of-hand, some drug being dropped into the wine. Markos also, according to Irenaeus, had a trick of filling a larger cup by pouring a liquid backwards and forwards from it into a smaller, at the same time uttering an incantation, which Epiphanios says was done by some boiling or effervescence (ὅστε καὶ ὑπερεκχεῖσθαι ἐξ[ποτηρίου]), and Hippolytos (who twice refers to his book on the magicians, see p. 277) that some moist drugs have a flatuosity (τῆς τοῦ ὑγροῦ μίξεως, ὄντος φυσώδους). The trick was probably done by adding a frothing substance like soap-wort (saponarin), or a colloid. The concoction had to be drunk quickly, since it soon subsided.

Markion of Sinope in Pontos (*c.* A.D. 150), and Bardesanes (Bar Daiṣan) of Edessa (A.D. 154–224), are very important in the history of religion but of no interest to us.

Coptic Gnostic Works

The unique Coptic (Sahidic) manuscript of *Pistis Sophia* belonged to Dr. Askew and was mentioned by C. G. Woide (1778), who gave it this name. He made a copy which was seen by other scholars.[4] The original MS., bought for ten guineas by the British Museum in 1785, is a fine parchment codex of 174 ll., paginated in Coptic (showing that four leaves are missing); the text, containing many Greek words, is written in two contemporary hands. The condition of the codex suggests that it was written for one of the wealthy

[1] I, xiii, 6; xxi, 1.
[2] *Ref.*, vi, 42.
[3] *Panar.*, XXXIV, iii; (1), i, 234.
[4] J. Matter, (1), 1828, ii, 103 f.

gnostics seen by Epiphanios when he was in Egypt in A.D. 330–334, and it was perhaps buried in a tomb. The Coptic text was published (with a Latin translation by J. H. Petermann) by M. G. Schwartze (Berlin, 1851) and Carl Schmidt (Copenhagen, 1925); a German translation by Schmidt (Leipzig, 1905, *Koptisch-Gnostische Schriften*, with good Greek index, in GCS was revised in 1925,[1] and an English one (from Petermann's Latin) by Mead.[2] It was regarded as Ophite, or Valentinian, but is probably (Harnack, Schmidt) a work of a large group (the Severiani) of Syrian Barbelo-gnostics, influenced by late Hellenistic Egyptian ideas.[3] It is in four parts, the first without title, the second entitled by a later hand 'The Second Book of Pistis Sophia', the third an extract from 'The Mystery of the Ineffable', and the fourth of a different character. The Coptic MS. is probably of A.D. 350–400, the unknown Greek original perhaps (as Woide suggested) of A.D. 250–300, the fourth part perhaps A.D. 200–250.[4] The work, intended for an educated circle,[5] is Christian, and generally (except the fourth part which contains magic words and spells) more elevated in tone than earlier gnostic works. It is mostly in the form of dialogues of Jesus with disciples, and Mary Magndalene plays a prominent and intelligent part.[6] The gnostic elements include a fall of Sophia, who is the same as Pistis; the two form the first and last female members of the Dodekad of Valentinus.[7] Mary is called pneumatic (πνευματική) and the Holy Spirit is πνεῦμα.[8]

The division of men into πνευματικοί, ψυχικοί, and ὕλικοί, as in Valentinus (see p. 264), is sometimes implied but is not given explicitly.[9] All souls contain a germ of spiritual life but (except those of the apostles) are burdened in the body (σῶμα) with matter (ὕλη) incited to evil by the counterfeit spirit (αντίμιμον πνεῦμα) and fate (μοῖρα), and subjected by evil impulses (κακία τρυφῶν) to destiny (εἱμαρμένη) and the dominion of the archons.[10] Sinners are given every chance of redemption by transmigrations (παλιγγενεσίαι). The soul (ψυχή) is not released from the changes (μεταβολαί) of the body (σῶμα) until it has become worthy in its last cycle (κύκλος).[11] At the end of the world, when redemption is completed, the human souls, originally inferior to and immeasurably weaker than the archons, become perfected (τέλειοι) and take their places above them.[12]

The cosmology is complicated and is not consistent in the different books. (References in the text are to Schmidt, 1925.) A mixture of light and matter (ὕλη) forms the material or mixture (κερασμός) (158) of the lower world with

[1] *Pistis Sophia. Ein gnostisches Originalwerk des dritten Jahrhunderts*, Leipzig, 1925; in quotations as 'Schmidt' unless 1905 is added.

[2] (4); another by G. Horner, 1924, from the Coptic.

[3] Buosset, (1), 165; Budge, (1), i, 266, 280; de Faye, (1), 269–333, 507; Harnack, TU, 1891, vii; K. R. Kostlin, *Theologische Jahrbücher*, ed. Baur and Zeller, Tübingen, 1854, xiii, 1–104, 137–96; Leisegang, (1), 1941, 350–89; Lipsius, DCB, iv, 405; Mead, (4); J. Moffat, ERE, x, 45; Schmidt; Scott-Moncrieff, (1), 148, 176; Ueberweg, (1), ii, 39; Wetter, 173.

[4] Buonaiuti, 12; Leitpold, in Brokcelmann, (2), 140; Schmidt, 1924, xvii, li; Verbeke, 304, 314 (end of 2 cent. A.D.; Schmidt thought this too early).

[5] Hopfner, *Beih. a. O.*, 1925, iv, 80; Nock, (1).

[6] Schmidt, 42, 280. [7] *Ib.*, xxi.

[8] *Ib.*, 221, 225–6, 228, 244; 273, 276.

[9] De Faye, 290; Lipsius, DCB, iv, 412.

[10] Schmidt, 206. [11] *Ib.*, 209. [12] *Ib.*, 100, 219, 245–6.

four corners (261–2,272). The rulers of the night formed the lower spheres.[1] In the middle region sits the Virgin of Light (Παρθένος τοῦ φωτός) (86, 143, 174), the judge of souls, with seven other virgins of light (157, 212, 239) and fifteen helpers (παραστάται) (144), also the sun and moon, which send light, obscured by many veils (καταπετάσματα) to the regions below (142). Below, on the left, are the Invisible (ἀόρατος) God (2, 132), his great power Barbelo (34, 264, 273), and three triple gods (30, 157, 283), the two highest Βαινχωωωχ and Ιψανταχουνχαϊνχεωχ (xxi, 264, 273, 283) are names which occur in magic papyri.[2] Below the middle region is the World (κόσμος), consisting of the firmament (στερέωμα) (13, 15, 180, 232), the earth, and the underworld divided into twelve places of punishment and comprised of three main divisions, Orchos, chaos, and outer darkness (175, 233, 242).

The disc of the sun is a great dragon with its tail in its mouth (see below); the stage (βάσις, or perhaps boat, βάρις) of the moon is drawn by two white cattle and steered by a male and a female dragon and at the stern by a boy [Harpokrates] (262). The 'true' and 'incorruptible (ἄφθαρτοι)' names of the five great archons who control the world are Chônbal (Zeus), Chôsi (Aphrodite), Orimûth (Kronos), Tarpetanûph (Hermes), and Munichunaphôr (264).

In the outer darkness is a great dragon (δράκων; *Pistis Sophia* distinguishes between dragon and serpent), with its tail in its mouth [Ouroboros], outside and encircling the whole world (102). Inside this circle are the twelve chambers (rooms, or storehouses) of punishment, each containing a named demon (233, 262).[3] The dragon has a mechanism for taking its tail out of its mouth, which occurs when one of its 'true names' is uttered, and so a captive soul can slip out (xxxi, 233, 262).

The five great archons have 365 workmen who fashion the soul, control the processes of generation and gestation, and decree every event in life up to the day and manner of death. Only the gnostic key to the mysteries confers escape from their control, and even the finding of this key is subject to the rule of the stars (256, 260, 272, 283).[4]

The evil spirits of the five great archons (planetary spirits) constitute an ἀντίμιμον πνεῦμα or 'counterfeit spirit' (Mead's translation), attached to the soul like a skin or garment (ἔνδυμα) and constantly trying to mislead it (46, 206–10, 212, 215–16, 247–9, 250–1); it forms a kind of cloud or shadow around the soul, weighing it down.[5] The counterfeit spirit is like 'the material (ὑλικόν) alloy of copper with the purified silver of light' (214). Its influence is overcome only with difficulty by sacraments of holy water or holy oil (ὀποβαλσαμον). It attaches itself to everything good and causes its downfall,

[1] The outer sphere of the fixed stars was supposed to move to the right, that of the planets to the left: Philo Judaeus, *De Cherubim*, vii; *Works*, tr. Yonge, 1854, i, 180.

[2] Reitzenstein, (5), 174, 178, 204.

[3] These are probably the twelve divisions of the old Egyptian underworld, Duat, or Tê: Bousset, (1), 101; Horner, 160, 192; Mead, (4), 320–33; Scott-Moncrieff, 12, 47, 178.

[4] Horner, 182, 198; Mead, (4), 336, 341, 355, 393.

[5] Bousset, (1), 102, 166, 294, 296 f., 366; *A. Rel.*, xviii, 134; Eisler, (1), 561; (3), 184, says this is the Persian *paityâra*, a spirit opposing the work of creation of the good spirit by 'imitations of the opposite'; Scott-Moncrieff, 166, 192, thought it was the Egyptian *ka*, or double; the idea is in Valentinus.

attracts the base and corrupted, inclines men to sin, and combines in the soul with the power of the divine light. The soul can be released from the seals (σφραγῖδες) and bonds of the counterfeit spirit by appropriate mysteries (μυστήριον), including the uttering of its 'true name', which the *Pistis Sophia* claims to reveal; souls then become complete (τέλειοι) and purified (καθαρίζειν) (219, 248). The archons formed the souls from the dregs of matter[1] after all the light was squeezed out; they knead this, divide the mass into souls, and seal them with the counterfeit spirit (i.e. incorporate some of the planetary spirit of evil). The name for the dregs of matter is 'leaven' or 'yeast', but the apostles are the 'leaven of all invisibles and archons' (25–8, 181–4).[2] New souls are also made from the sweat, tears, and breath of the archons (246–7). The alchemist Zosimos calls the αντίμιμον πνεῦμα the counterfeit demon (ἀντίμιμος δαίμων) (see p. 226).[3]

He who knows all the mysteries has knowledge of light and darkness, beasts, birds, and reptiles, and the matter (ὕλη) of gold, silver, copper, iron, lead, turquoise (λάϊον = καλλάϊνον), glass, wax, herbs, waters, wild denizens (θηρία) of the sea, demons, men, heat and cold, frost, planets, aeons, dekans, the five trees, the seven amens, the emanations (προβολαί) of light, etc. at great length (154–8).

The fourth part of *Pistis Sophia*[4] is usually regarded as an older work, but since it describes the fate of souls after death it is probably in its right place. It describes a ceremony in which Jesus utters strings of vowels and apparently unintelligible words which occur in magic papyri and in the *Bruce Papyrus* (see below), and some may be disfigured Egyptian, Syrian, Persian, Hebrew, or Aramaic words.[5]

Bruce Papyrus

The Coptic *Bruce Papyrus* was brought from Egypt in 1769 by James Bruce, and acquired by the Bodleian, Oxford, in 1842. It was copied by Woide. It is a codex written in the same dialect as *Pistis Sophia*, in two hands of the 5 and 5–6 cents.[6] The first part (mutilated and disarranged) consists of two *Books of Jeû*,[7] the first full of meaningless words and strings of letters, magic diagrams (including an 8-rayed star terminated by circles), etc., as in magic papyri. The second book resembles the fourth part of *Pistis Sophia* (which mentions the books of Jeû).[8] The work is Christian, probably Barbelognostic, perhaps Enkratite.[9] Both it and *Pistis Sophia* (276) refer to a 'baptism by fire', which Eisler[10] thinks was done with strong wine to which salt, sulphur (θεῖον) and manna (μαννα, perhaps incense) were added, kindled and poured over the head. He reproduces[11] a head of Dionysos from Smyrna, said to show

[1] The *faecem materiae* in Irenaeus, I, xxx, 5, an Ophite term.
[2] Horner, 169. [3] Berthelot, (2), ii, 232.
[4] Schmidt, 261–77, 277–86; Horner, 180–99.
[5] Hopfner, PW, xiv, 340; Legge, (1), ii, 181; Scott-Moncrieff, 170 f.
[6] C. Schmidt, Gnostische Schriften in Koptischer Sprache aus dem Codex Brucianus, TU, 1892, viii; *id.*, TU, 1905; de Faye, (4), 320 f., 507 f.; J. Matter, (1), ii, 107; Mead, (2), 535 f., 170; Scott-Moncrieff, (2), 183–97.
[7] Mead's emendation, to *Ieou* = Tetragrammaton, is accepted by Scott-Moncrieff.
[8] Schmidt, 258; Horner, 123. [9] Schmidt, 1905, xxiv.
[10] (3), 139, 145, 149. [11] Fig. 61, p. 152.

the 'fire in the curls of hair (πῦρ ἐπὶ βοστρυχοις)' mentioned by Euripides (*Bacchae*), but it looks to me like an ordinary curly head, the same above and below the fillet. The alcohol in the wine would be πνεῦμα; in the Middle Ages it was *aqua vitae*. In another part there is a sacrament in which wine is turned into water, with which the disciples are baptised (the reverse of the miracle of Jesus).

The *Codex Brucianus* contains a long treatise (incomplete at the beginning and end) of a different character from *Pistis Sophia* and the *Books of Jeû*.[1] It is apparently a translation of a Barbelo-gnostic (Sethian) work of about A.D. 200–250, hardly, if at all, Christian (it does not mention Jesus). The main elements are Syrian-Hellenistic and there is little Egyptian influence, so that it may have been imported, perhaps from Rome. It refers to Setheos (= Seth), Marsanes (Marsianos), and Nikotheos, who is also mentioned by Porphyry and Zosimos (see p. 226); it gives a fantastic account of the birth and evolution of the transcendental Word, and a salvation largely by magic words and formulae and the exhibition of seals (χαρακτῆρες).

A 5-cent. Berlin Coptic papyrus (*Codex Reinhardt*) from Ikhmīm contains three works, *Εὐαγγέλιον κατὰ Μαριάμ* (also called *'Απόκρυφον 'Ιωάννου*), *Σοφία 'Ιησοῦ Χριστοῦ*, and *Πρaξεις Πετροῦ*, the first named and used by Irenaeus[2] and hence existing in a Greek original before A.D. 180. It is a Barbelo-gnostic work.[3] Harnack said it attempts to 'develop a psychological process inside primordial being'.

A library of 48 Coptic works, 42 gnostic, found in a jar near Nag-Hammadi in Egypt, beautifully written on good papyrus (A.D. 3–4 cent.) contains works of Barbelo and Sethian character and was perhaps by the gnostics described by Plotinos. Some texts mention Hermes and Adamas, Zoroaster and Zostrien, and Nikotheos.[4] One large work (*Jung Papyrus*) is thought to contain material from Valentinus.[5]

[1] Schmidt, 1905, xxvi, 335–67; Charlotte A. Baynes, *A Coptic Gnostic Treatise contained in the Codex Brucianus*, Cambridge, 1933 (only a summary of Schmidt).

[2] I, xxix–xxxi.

[3] Buonaiuti, 7; de Faye, 1925, 396; Mead, (2), 1900, 580 f., 592; Pallis, 200; C. Schmidt, *Sitzb. Akad. Berlin*, 1896, 839–46; Harnack, *ib.*, 846; W. C. Till, *La Parola del Passato*, Naples, 1949, iv, 230–49 (in German).

[4] H. C. Puech, *Coptic Studies in Honor of W. E. Crum*, Boston, 1950, 91–154 (Zoroaster and Zostrien, 107, 134; Seth, 108 f., 114, 127 f.; Hermes, 109; Adamas, 108; Nikotheos, 134, 145; Pistis Sophia, 151); *id.*, *Revue Hist. Rel.*, 1947–8, cxxxiv, 244; *id.* and J. Doresse, *Compt. Rend. Acad. Inscr.*, 1948, 87; *id.*, *Bibliotheca Orientalis*, 1949, vi, 102; T. Mina, *Vigiliae Christianae*, Amsterdam, 1948, ii, 129; Doresse, *ib.*, 137; Doresse and Mina, *ib.*, 1949, iii, 129–41.

[5] Puech, Quispel, and van Unnik, in F. L. Cross (ed.), *The Jung Codex. A Newly Discovered Gnostic Papyrus*, 1955; *Evangelium Veritas. Codex Jung*, Coptic text, and trs. (French, German, English) by Malaline, Puech, and Quispel (*C. G. Jung Institut Stud.*, vi), Zurich, 1956.

CHAPTER XIV

MAGIC

Magic in various forms appeared early among all nations and many theories have been proposed to account for its origin;[1] in its 'scientific' aspects it is based on the theory of 'sympathy', or a relation among all things, animate or inanimate.

Magic is an important component of the earliest religious documents of Egypt, the Pyramid Texts (V–VI dyns., 2625–2475 B.C.).[2] Egyptian medicine was also largely magic but had a rational part.[3] The Egyptian lector priest (*kheri-ḥeb*) read spells from books, others made amulets and talismans.[4] In a story in the *Book of the Dead*, water which a dead man was beginning to drink suddenly burst into flames.[5] The spoken words of a spell, 'words of power' (*hekau*) must be correctly pronounced and intoned. The pictures on the walls and coffin had a magic significance.[6] As the old religion decayed, the Egyptian gods, particularly Thoth-Hermes, languished in the service of magicians. Smaller gods and demons could be summoned and compelled to act by repeating formulae or by threats, but especially by uttering the 'true name' of a god, several being used to be sure of getting the right one. Even great gods like Seth-Typhon could so be summoned. After a god or demon had played his part he was banned by a formula and a protective charm. The utterance of the 'true name' was dangerous but it compelled the god to do the will of the magician.[7] Iamblichos[8] reported that the Egyptian magicians 'threatened' the gods.

In magic papyri *pneuma* (πνεῦμα) is a material fluid, as it was with the Stoics (see p. 158).[9] The animation of idols was achieved by giving them

[1] R. R. Marett, ERE, viii, 245; N. W. Thomas, EB[11], 1911, xvii, 304.

[2] Bonnet, 435; Budge, (2); Cumont, (5), 163 f.; Erman, (1), 222, 237, 252, 256, 295–313 Magie und Zauberei); Gardiner, ERE, viii, 262; F. Ll. Griffith, (1); T. Hopfner, (1)–(3); *id.*, PW, xiv, 301 f.; Lexa; Maspero, Hypogées royaux de Thebes, in *Ann. Musée Guimet*, 1889; *id.*, *J. des Sav.*, 1899, 69, 154, 277; *id.*, (1); E. Naville, *The Old Egyptian Faith*, tr. C. Campbell, 1909; Partington, (1), 180; Scott-Moncrieff; A. Wiedemann, (1), (2); *id.*, Magie und Zauberei im alten Ägypten, in *Der alte Orient*, 1905, v, no. 8.

[3] Partington, (1), 180 f.

[4] Berthelot, *J. des Sav.*, 1899, 242, 271; Budge, (2), 65 f.; Erman, (1), 187 f., 201, 208 f., 210, 252, 256, 293–313.

[5] Erman, (1), 222.

[6] Budge, (2), 65 f., 104 f., 116; Scott-Moncrieff, 7, 12, 42, 100.

[7] Blau, 43, 117; Budge, (2), 33, 43, 53, 71 f., 137 f., 157 f., 168 f.; Erman, (1), 295 f., 303, 311; (3), 190, 301, 405; Festugière, (1), i, 26, 293; Hopfner, (1), 247 f.; *id.*, PW, xiv, 334, 340; Kenyon, i, 73; Reitzenstein, (2), 295; A. Wiedemann, (2), 421; *id.*, *A. Rel.*, 1928, xxvi, 357.

[8] *De Myst.*, vi, 7; Reuvens, (1), 1e Lettre, 41 f.

[9] Festugière, (1), i, 283 f.; Reitzenstein, (4), 1927, 284 f.

pneuma through 'animating words (ὀνόματα ζωτικα)'.[1] In the Hellenistic period the priest or magician identified with the god, ἐγώ εἰμι *N.*, 'I am *N.*'.[2]

In the cuneiform tablets of Babylonia and Assyria, magic also plays a prominent part; medicine was largely magical, although it had rational elements. The methods were very like the Egyptian.[3]

In the Ptolemaic period the Egyptian magicians were probably lower priests, but in the Hellenistic and Roman periods Jews, who had their own books of magic, were prominent as magicians, the profession being very profitable.[4] Jewish magic is largely Egyptian and Babylonian, with Iranian, Orphic, Hermetic, and Neopythagorean influences (especially Bolos of Mendes).[5]

The Jews were regarded as expert in magic and astrology, particularly in Egypt, Cyprus, and Thrace (these were places where alchemy is said to have flourished)[6] and Jewish names and words occur frequently in magic papyri.[7] Jewish works on magic were attributed to Solomon, a great magician;[8] they were condemned by William of Auvergne and Roger Bacon.[9] Solomon is said by the alchemist Zosimos (A.D. 250–300) to have composed a book on the seven heavens which dealt with the banning of demons in jars.[10] Jewish books on magic attributed to Solomon, etc., are mostly late forgeries.[11] Jewish magic was important in Byzantine[12] and later times, when it was a profitable trade.

The Greeks were far from being exempt from superstition and belief in magic.[13]

[1] Hopfner, (1), 241–2.

[2] Anrich, 89, 96; Budge, (2), 4, 157; Erman, (1), 297; Hopfner, (3), 1921, 173–88; Otto, (2), ii, 257; Pfister, PW, xi, 2133 f., 2155 f., 2164; Wetter, (1), 85.

[3] G. Contenau, *La Divination chez les Assyriens et les Babyloniens*, 1940; *id.*, *La Magie chez les Assyriens et Babyloniens*, 1947; Cumont, (1), 183 f., 278; Farnell, 295 f.; C. Fossey, La Magie Assyrien, in BEHE, *Sciences religieuse*, 1902, xv; King, ERE, viii, 253; Lenormant, (3), 227 f.; Meissner, ii, 214 f.; Partington, (1), 310; Z. A. Ragozin, *Chaldea*, 1889, 255; R. C. Thompson, *Semitic Magic, its Origin and Development*, 1908.

[4] E. W. Barnes, *The Rise of Christianity*, 1948, 37; Blau, (1); Ganschinietz, PW, ix, 693; Gaster, ERE, viii, 300; Legge, (1), i, 107; D. Smith, *Life and Letters of St. Paul*, 1919, 232; R. Stübe, *Jüdisch-babylonische Zaubertexte*, Halle, 1895; Tarn, (1), 205; Thorndike, (1), i, 59, 431, 461.

[5] Blau, 43 f., 79, 85, 117, 127, 130, 142, 156, 159, 161; Budge, (4), 225 f., 288 f.; Fabricius, (2), i, 1016 f., 1042 f., 1050; Gaster, *Academy*, 1895, xlviii, 552; Karppe, 281 f.; E. Meyer, (2), ii, 119, 365; Nock, (1), 223, 226, 228; Reitzenstein, (2), 186; Thorndike, (1), ii, 279; Wellmann, (6), 56.

[6] Harnack, (1), 93, 440, 489; Thorndike, (1), i, 436 f.

[7] Hopfner, (1), 251 f.

[8] Josephus, *Antiq.*, VIII, ii, 5.

[9] Thorndike, (1), ii, 279 f., 342 f., 351 f., 660 f.

[10] Berthelot, (4), ii, 265.

[11] *Clavicula Salamonis . . . described by N. Gollancz*, 1903; *Sepher Maphteah Shelomo (Book of the Key of Solomon): an exact facsimile . . . by H. Gollancz*, Oxford, 1914 (Hebrew MS. of *c.* 1716); *The Testament of Solomon* (in Greek), ed. and tr. C. C. McCown, in *Untersuchungen zum Neuen Testament*, ed. H. Windisch, Leipzig and New York, 1922, ix, no. 1; H. A. Groschuff, *Nova Librorum Rariorum Conlectio qui vel integri inseruntur vel accurate recensentur*, Halle, 1715, Fasc. iv, 747–81; Gaster, *The Sword of Moses, an Ancient Book of Magic*, 1896 (13–14 cent. MS.); H. Gollancz, *The Book of Protection. Being a Collection of Charms* [of Jewish origin], tr. from Syriac, 1912 (18–19 cents.).

[12] Niketas, *Manuel Comnenus* [A.D. 1143–80], iv, 7; Migne, PG, cxxxix, 489.

[13] Abt; Antonius van Dale, *Dissertationes de Origine ac Progressu Idolatriæ et Superstitionum: De Vera ac Falsa Prophetia*; *Uti de Divinationibus Idololatricis Judæorum*, 4°, Amsterdam, 1696 (762 pp.); J. W. Draper, *Intellectual Development of Europe*, 1864, i, 180; *id.*, *History of the Conflict between Religion and Science*, 1875, 18; Eitrem, OCD, 529; J. Harrison, 140 f., 190; R. Heinze, *Xenokrates*, Leipzig, 1892; H. Hubert, in D-S, 1904, III, ii, 1494–1521; J. E. Lowe, *Magic in Greek and Latin Literature*, Oxford, 1929; Maury, (1), (2); Migne, (3); K. F. Smith, ERE, viii, 269; Tamborino, De antiquorum dæmonibus, RVV, 1909, VII, iii; Thorndike, (1), i, 21 f.

Lucan (and Apuleius) may have used Neopythagorean sources in Rome.[1] Hippokrates[2] said magicians pretended to know how to bring down the moon, eclipse the sun, and produce storms, fine weather, rain, and dryness.

The Etruscans were noted for magic plants and Roman magic may have come from them.[3] 'Ephesian words (Εφέσια γράμματα)' were also prevalent in Asia Minor, where they were supposed to have been invented by the Idaean Dactyli.[4] Lead (and silver) plates, and lead books with hinged leaves, have symbols like those of alchemy.[5]

Apuleius of Madaura in North Africa (b. *c.* A.D. 123), who studied in Carthage and Athens, and visited Rome, describes magic in his *Metamorphoses* while in his *Apologia* (*c.* A.D. 156–8) he defended himself in a trial on the charge of being a magician.[6] Theological philosophers were called magicians, philosophers who studied natural science were called atheists.[7]

He describes a magician's 'laboratory'[8] and the use of Arabian drugs.[9]

The *Confession* attributed to Cyprian, later bishop of Antioch, spurious but composed before A.D. 300, says that he travelled to learn magic, and returned to practise in Antioch;[10] he learnt in Greece how matter is combined and divided (ἵνα μάθω ὕλης συγχυσιν καὶ διαίρεσιν), in Phrygia the movement of the blood (αἱμάτων φορὰς) and the pulse, in Egypt ideas of transfigurations, imitations of earthquakes, and all kinds of sins and vices, in Chaldaea lore of air, fire, and light, the qualities of stars and herbs, and the devil's gold which is not genuine (χρυσὸν δωρούμενος, ἀλλ' οὐκ ἐνύπαρκτον).

Some magic tricks practised by the gnostic Simon Magus (*c.* A.D. 50) (see p. 254) are mentioned in the *Recognitions* and *Homilies* of *ψ*-Clement of Rome (see p. 181). He could fly, change himself into gold, melt iron, make dishes move themselves,[11] and produce abundance of gold.[12] His consort Helena looked out of all the windows of a tower at once.[13] Simon made a boy by condensing human breath (πνεῦμα) into a cupping glass (σίκυος); after making a picture of the boy as a record, he changed him back again into air by the reverse process.[14] Simon boasted that 'I have already achieved many things by experiment' (multa etenim iam mihi experimenti causa consummata sunt).[15] He pretended to animate idols and this was tested by counterpoising them on a balance and commanding them to become heavier or lighter; 'but it did no- happen.'[16]

[1] Hopfner, PW, xiv, 320; Kenyon, i, 173; Maury, (1), ii, 503; Nock, (1), 225–7; Riess, PW i, 30.
[2] *De morbo sacro*, 1; *Oeuvres*, ed. Littré, vi, 358.
[3] Hopfner, PW, xiv, 320.
[4] Gressmann, *Beih. a. O.*, 1925, v, 20; Immisch, Ro., ii, 1587; Kern, PW, iv, 2018; Kuhnert, PW, v, 2771; Maury, (1), i, 69; iii, 160; Tümpel, PW, iv, 2058.
[5] Carbonelli, 11.
[6] Abt, 2, 76; H. E. Butler and A. S. Owen, *Apulei Apologia*, Oxford, 1914; tr. Butler, Oxford, 1909; E. Rohde, *Rhein. Mus.*, 1885, xl, 66; Schwabe, PW, ii, 246–58; Thorndike, (1), i, 221–41; *Works*, tr., 1881.
[7] *Apol.*, 27, 31; *Works*, 273 f.; Magicians were often called 'philosophers', Cumont, (1), 279.
[8] *Metam.*, iii, 17, 21; Thorndike, (1), i, 228 f.
[9] *Apol.*, 6; *Works*, 252.
[10] *Acta Sanctorum*, 1867, sept. vii, 204 f.; Festugière, (1), i, 38 f., 369 f.; Thorndike, (1), 428 f.
[11] *Recog.*, ii, 11; iii, 57; x, 53, 56; *Homil.*, ii, 32.
[12] *Recog.*, ii, 9. [13] *Recog.*, ii, 12. [14] *Homil.*, ii, 26. [15] *Recog.*, ii, 5–9. [16] *Homil.*, ix, 15.

Simon's tricks probably came from Bolos of Mendes by way of Anaxilaos (see p. 218), since ψ-St. Cyprian[1] says Simon's followers pretended that in their baptism fire appeared on the surface of the water into which they descended, a trick like one of Anaxilaos. The tricks of a more chemical character of the gnostic Markos (*c.* A.D. 150) have been described (see p. 268).

Alexander of Abonoteichos in Paphlagonia (*c.* A.D. 105–75) is described by Loukian.[2] He performed tricks which are also described by Hippolytos: foaming at the mouth after eating soapwort, reading sealed letters by cutting through the seal with a hot needle, or taking an impression of it in Bruttian pitch, bitumen, and powdered glass, or wax and mastic, or gypsum and glue; and speaking through a tube composed of the windpipes of cranes attached to an artificial head.

Loukian of Samosata near Antioch (*c.* A.D. 120–200), a lawyer who lived in later life in Athens, introduced pieces of out-of-the-way information indicating wide reading; he was a trenchant critic of superstition. In *The Liars*[3] he satirised superstitious medicine and Egyptian magicians living in tombs. His *True History* (Ἀληθὴς ἱστορία)[4] tells of inhabitants of the Moon who wore clothes of soft glass, drank liquid air, and fed only on the fumes from frizzling grasshoppers;[5] also of a stela of electrum set up half-way between the Sun and Moon (this metal is an alloy of gold and silver, associated with the Sun and Moon).[6]

A detailed account of magicians' tricks is given in the *Refutation of all Heresies* (bk. iv, chs. 28–42) which is also by Hippolytos. The text begins abruptly and part is missing.[7] The magician, burning Egyptian incense called *kyphi* (κῦφι),[8] wrote questions in Hebrew letters (he was probably a Jew) on a piece of paper, which was burnt, the questions being carried to the demons in the smoke. He uttered incantations in Greek and Hebrew, contriving to write the answers on paper [with an infusion of galls] and the apparently blank sheet was put in water in which vitriol (χαλκάνθον) was dissolved, and the writing appeared. Or he wrote the answers with solution of vitriol and developed the writing by holding the paper over the fumes of (burning) gall nut. Letters written with milk and dried appear when the paper is rubbed with burnt paper, and urine, sauce (γάρον) or τιθυμάλον

[1] *S. Thasci Caeciliani Cypriani Opera Omnia*, Pars iii, *Opera Spuria*, ed. G. Hartel, Vienna, 1870, iii, 90: *De rebaptismate*, c. 16.

[2] *Alexander Pseudomantis* (written after A.D. 180), *Opera*, ed. Jacobitz, ii, 115–43; Works, (1), ii, 213; M. Caster, *Études sur Alexandre ou le Faux Prophète de Lucien* (text and tr.), 1938; A. B. Cook, ii, 1083; Cumont, Alexandre d'Abonotichos, *Mém. Couronnés et autre Mém. Acad. Roy. Belg.*, 8°, 1887, xl; Festugière, (1), III, ccviii; Friedländer, iv, 179, 473; Helm, PW, xiii, 1730 (Loukian); Jowett, DBM, i, 123; E. Meyer, (2), ii, 415; Réville, (1), 132; Riess, PW, i, 1444; Thorndike, (1), i, 277.

[3] Loukian, (1), iii, 230.

[4] i, 20–25; Loukian, (1), ii, 145; (3), ii, 40; (4), i, 129–48.

[5] Lippmann, *Chem. Ztg.*, 1931, lv, 819.

[6] Partington, *Nature*, 1931, cxxviii, 666.

[7] Hippolytos, (1), 88 f.; (4), 93 f.; (5), i, 40 f., 92 f.; Bousset, EB[11], 1910, xii, 152; Burckhardt, (1), 220; Diels, *Abhl. Akad. Berlin, phil.-hist. Kl.*, 1913, no. 3, 21 f.; Festugière, (1), i, 79; Ganszyniec, PW, xii, 1886; *id.* (Ganschinietz), Hippolytos Capitel gegen die Magier, TU, 1913 (ser. 3), ix; Krüger, EB[11], 1910, xiii, 519; Langdon, JRAS, 1922, 468; Legge, (1), 1, 87, 109; Nock, (1), 227; Wellmann, (5), 57 f.

[8] Partington, (1), 169.

ὀπος (juice of Euphorbia) or fig-tree juice.[1] A text is written on the left hand with gall juice and strong vinegar, then the sorcerer takes up a liver and, after some delay, draws it away, when the impression is seen written upon it.[2] The demon Phre (ϕRe, i.e. the Coptic article ϕ + Rē, the Sun god)[3] 'or some other' is invoked.

The magician is assisted by a boy, to whom (in the dark) he speaks at a distance through a tube formed of the windpipes of cranes, storks, or swans, or ten brass tubes telescoping into one another, or moist hide wrapped round a stick, or a book (a roll of papyrus or parchment) pulled out. All the time the magician shouts and strikes blows at the audience to distract attention. He covered a lump of 'fossil salts (ἁλῶν ὀρυκτῶν)' (decrepitating rock-salt) with Tyrian (Τυρρηνικῷ) wax,[4] divided a piece of incense into two parts, put in a grain of the salt, and joined them together again. He put this on burning coals. When it is consumed the salts 'bounding up' (οἱ ἅλες ἀναπηδῶντες: the decrepitation of rock salt) give the impression of a strange vision. The dark blue dye (το ἰνδικὸν μέλαν) in the incense produced a blood-red flame (indigo vapour is purple).

He made a scarlet liquid from melted wax and alkanet (ἄγχουσα), and caused burning coals to move by putting powdered alum (στυπτηρία) underneath which bubbled and moved the coals. Eggs of various colours were made by perforating at both ends, taking out the white and throwing in minium (ἔμβαλε τὸ μὲν τῆς σινώπιδος) or writing ink (τοῦ γραφικοῦ μέλανος); the openings were closed with scrapings of eggs mixed with fig-juice (μετ' ὀποῦ συκῆς).[5] A sheep was made to decapitate itself by rubbing its throat with an irritant composed of equal parts of bryony (βρυωνία), marsh salt (ἀδάρκη), and squills (σκίλλα), and putting a sword near, when the sheep rushed against it. Mercury (ὑδράργυρος), a deadly poison (θανατηφόρον φάρμακον), is put into the ears of the sheep.[6]

Sea-salt (ἀφρὸς θαλάσσης) boiled in a pot with sweet wine (μετὰ γλυκέων) takes fire at a lighted candle but if poured over the head does not burn it. This would probably be an alcohol flame.[7] The effect is better if sulphur or incense (μάννα) is used instead of salt. Thunder is made by dropping stones on bronze plates. The magician pretended to plunge his hands in boiling tar, but it is cold and he put vinegar and soda under it, which bubble and make the tar seem to boil. A brick is made to burn because it had been soaked with oil. If the feet are coated with isinglass (ἰχθυοκολλα) and asbestos powder (σαλαμάνδρα) they are not scorched on walking over burning coals. Impressions of seals are taken, the letter opened and read, and the seal made again by

[1] Pliny, xxvi, 39, gives the milky juice of *tithymalos characias* (Euphorbia or Spurge).
[2] A Chaldaean liver-diviner, Sum-iddin, wrote backwards on his hand with ink, and impressed this on the liver; Meissner, ii, 244.
[3] Legge, (2), i, 92; Hippolytos was using an Egyptian book of magic.
[4] Also used in the Leyden Magic Papyrus V, Hopfner, PW, xiv, 350.
[5] Colouring eggs by dipping them into wine with crocus (saffron), or oil with cummin and vinegar, was a trick used by Anaxilaos; Wellmann, (5), 58 f.
[6] Wellmann, (5), 59: from Bolos.
[7] Eisler, (3), 149; Diels incorrectly thought distilled alcohol was used; Lippmann, (3), ii, 60 f.

the impression (the seal was cut with a hot wire). The magician made fire and smoke come from his mouth, into which he had put some smouldering tow.[1]

Divination by the cauldron is done in a chamber with a blue ceiling, which is reflected in water in the cauldron like the sky. But the bottom of the cauldron is glass and stands on a hole in the floor; beneath which assistants dressed up as gods or demons perform.[2] Fiery demons are made by painting figures on the wall with petroleum and setting light to them. Fiery flying Hekate is a bird covered with tow set alight and thrown up by an assistant when he hears an invocation (given by Hippolytos). Various optical illusions are produced with lamps and mirrors,[3] stars are imitated by fish-scales (phosphorescent ?) pasted to the ceiling.[4] An earthquake is produced by burning on coals the ordure of a weasel (κόπρον ἰχνεύμονος) with magnet (σιδηραγωγός) (the horrible smell would perhaps make things seem to swim about). A skull is made from the omentum of an ox, Etruscan wax, and gypsum and is connected with the windpipe of a crane through which an assistant speaks. Then burning coals and incense are put round it, and the skull vanishes (by the wax melting).

Ganschinietz[5] thought that both Loukian and Hippolytos had used a work of Celsus (κατὰ μάγων) and the lost part of Hippolytos may occur in Loukian's account of divination by enquiry of a spirit or demon in writing, since the first incomplete sentence in the account of the magicians in Hippolytos deals with this. Origen[6] did not know if the author of the work against magic was the same as the one he was refuting. Ganschinietz thought the book was a popular work on natural philosophy (*magia naturalis*) compiled from a book by the Neopythagorean, Thrasymedes (*c.* A.D. 200), also used by Simon Magus; Hippolytos[7] in another place refers to Θρασυμήδους τέχνη, 'mentioned above' (in the lost part). Wellmann,[8] however, thought the ultimate source was Bolos, perhaps through Anaxilaos.

Lare[9] describes tricks with alum, coloured salt, the bezoar stone, rhinoceros horn, etc., and divination in a pool of ink in a boy's hand, etc., which he saw in Cairo, and which worked very well. Magic was largely an experimental art, requiring years of study, a good knowledge of natural objects and processes (including chemical), and the use of special apparatus, some of which is described.[10] Some effects perhaps resulted from autosuggestion, hypnotism, or long fasting, but the magician was usually a common conjuror with very credulous clients.[11] The magician's assistant was usually a boy, chosen after an examination as worthy (ἄξιος) of knowing the tricks.[12]

[1] Athenaios, i, 35, says Xenophon the conjurer (ὁ θαυματοποιὸς) made an artificial fire (πῦρ αὐτόματον) issue from himself, and the same trick is reported of Eunous, a Syrian slave who led the revolt in Sicily in 130 B.C.; Hoefer, *Diodore de Sicile*, 1865, iv, 404.

[2] Cf. Ganszyniec, PW, xii, 1886.

[3] Hubert, DS, III, ii, 1516; Wetter, (1), 27 f.

[4] Berthelot, (2), ii, 351. 19; Wellmann, (5), 60 f. (from Anaxilaos ?); the optical tricks are mentioned by Iamblichos, *De Myst.*, iii, 14; Hopfner, PW, xiv, 375 f.

[5] TU, 1913, ser. (3), ix; Legge, (2), i, 92.

[6] *Contra Celsum*, i, 68.

[7] *Refut.*, vi, 7.

[8] (5), 58.

[9] *The Modern Egyptians*, 1846, i, 342 f., 344, 354–5, 366 f.

[10] Dieterich, (1), 157 f., 159–60; Thorndike, (1), i, 420, 422; ii, 177 f.

[11] Festugière, (1), i, 309 f.; *id.*, *Rev. Bibl.*, 1939, xlviii, 45 f.; Ganszyniec, PW, xii, 1885; Hopfner, PW, xiv, 388; Legge, (1), i, 109 f.; Maury, (2), 339 f.; Reitzenstein, (3), 1927, 127; Réville, 136 f.

[12] Festugière, (1), i, 348 f., 352 f.; Kenyon, 65; Lane, *The Modern Egyptians*, 1846, i, 369 f.; PGM, i, 180.

Ostanes

A *magus* ($\mu\acute{\alpha}\gamma o\varsigma$) was a member of the priestly Median tribe who officiated in Persian religious ceremonies. The first Greek use of the name in the sense of 'Magician' is in Sophokles (450 B.C.).[1] Then $\mu\alpha\gamma\epsilon\acute{\iota}\alpha$ came to mean sorcery ($\gamma o\eta\tau\epsilon\acute{\iota}\alpha$). The reason for the change of meaning is not quite clear, but the Persian *magus* used a magic wand, claimed to kindle the sacred fire by the sun,[2] and probably used spells for exorcising demons. The penetration of Persian religion by Babylonian astrology played an important part in its debasement.[3]

In Herodotos[4] Otanes ('Οτάνες) is the brother-in-law of Xerxes, whom he accompanied as leader of the Persians against the Greeks in 480 B.C.; he was a high official under Darius (521–485 B.C.), and an historical person.[5]

Vshtn occurs in an Aramaic record of an event in 407 B.C.,[6] and 'the books of Istn' are mentioned in an inscription in the Ptolemaic temple at Dendereh, and Maspero[7] thought Istn (or Astnu) was a name of Thoth-Hermes, but[8] this is doubtful.

Before 200 B.C. a work by an unknown author described some true magian teachings, but associated with astronomy and astrology. This book is lost but fragments may have survived in the *Oktateuchos* which was ascribed to Ostanes. It was used by Bolos of Mendes (see p. 211), who probably added to it parts on magic, mystical and cosmological speculations, mineralogy and the magic properties of gems, and medicine. The extended work was ascribed to a ψ-Ostanes (who became the 'Ostanes' of later authors), whose information was mainly derived through the *Περὶ Μάγων* of Hermippos (*c.* 200 B.C.) or the *Περὶ Μάγου* of Apion (see p. 181).[9] Ostanes, sometimes called a 'king', plays an important part in Hellenistic writings on magic and astrology; he was the equal of Zoroaster in knowledge of the stars,[10] skilled in the sympathetic and magic properties of stones, plants and animals,[11] a magic physician making amulets, and comparable with Orpheus.[12]

[1] Festugière, (1), ii, 224; Gray, ERE, iv, 818; Gressmann, (1), 138; Marett, ERE, viii, 245; Meyer, (2), ii, 74; Moulton, 428; Nock, in F. Jackson and K. Lake, 1933, v, 164–88; Smith, ERE, viii, 269.
[2] Maury, (2), 30.
[3] Bousset, (1), 225, 335, 376 f.; *id.*, *A. Rel.*, iv, 254; Lenorment, (3), 216 f.; E. Meyer, (1), iii, 94, 125; Scheftelowitz, *A. Rel.*, xvii, 241 (*magus* an Assyrian word); Zimmern, in Reitzenstein, (4), 1927, 155 (*magus* a Babylonian word).
[4] iii, 68–83, 141–50; vii, 61.
[5] E. Meyer, (1), iii, 34, 60, 151; Preisendanz, PW, xviii, 1609–42 (the original Persian name may have been Vištāna, Babylonian Uštani); Hystanes ('Υστάνης) in Herodotos, vii, 77, is a different person.
[6] Sayce and Cowley, *Aramaic Papyri discovered at Assuan*, 1906, 42; E. Meyer, (3), 72, 83.
[7] *Proceedings of the Society of Biblical Archaeology*, 1898, xx, 142; A. B. Cook, ii, 700; Eisler, (1), 573; Hoffmann, in Ladenburg, (1), ii, 524; Legge, (1), i, 108; Mallet, 97, 138; Mead, (1), iii, 296; Roeder, Ro., v, 853.
[8] Boylan, 201; Preisendanz.
[9] Abt, (1), 325; Berthelot, (1), 52, 70, 78, 83, 130, 163 f.; *id.*, (3), 11; Bidez, (2), i, 167–212; ii, 309–56 (bibl.); Dieterich, (3), 752, 758; K. Dilthey, *Rhein. Mus.*, 1872, xxvii, 375 (386 f.); Fabricius, (1)(*b*), i, 106; J. Freudenthal, *ib.*, 1880, xxxv, 409 (417); Gressmann, (1), 138; H. Kopp, (2), i, 407; U. F. Kopp, iii, 296; iv, 135; E. Meyer, (2), ii, 92; Morhof, (1), i, 111; Preisendanz, PW, xviii, 1609 f. (alchemical, 1629 f.), 1641; Reitzenstein, *A. Rel.*, viii, 182; *id.*, (2), 168, 363; *id.*, (7), 4; W. Scott, (1), iv, 5; Sprengel, (1), iii, 159.
[10] Boehm, PW, ix, 80; Eisler, (1), 428; Fabricius, (1)(*a*), i, 92; xiii, 354; Ganszyniec, PW, xii, 1883; Hopfner, PW, xiv, 372; Roeder, Ro., v, 853; W. Scott, (1), iv, 5.
[11] Lobeck, 235 f., 376, 887 f.
[12] Alexander of Tralles, (1), i, 564, 566; ii, 274.

The supposed works of Ostanes and Zoroaster, at first read only by the common people, entered the educated world from the I cent. B.C., from which time Ostanes and Zoroaster were regarded as the originators of magic, a view rejected by Pliny and the Christian authors but carried on into Byzantine and Arabic times.[1] Pliny[2] was of the opinion that magic originated with Zoroaster in Persia, or perhaps a second Zoroaster in later times; but the first who wrote on it was Osthanes (*sic*), who accompanied Xerxes.

'He 'disseminated the germs of this monstrous art and so infected all parts of the world . . . more particularly the Greeks not with a fondness only but with a rage (*rabies*) for the art of magic. . . . In the time of Alexander the Great this profession received additions from a second Osthanes, who accompanied this prince in his expeditions over every part of the world . . . [only Pliny reports this] . . . Osthanes says there are many kinds of magic, viz. with water, balls, air, stars, lamps, dishes, hatchets, etc. Pliny regarded magic very unfavourably, but admits that it has some shadow of truth.

Sanchuniathon, quoted by Philo of Byblos (*c.* A.D. 100), says that Ostanes wrote a book called Ὀκτάτευχος.[3] Nikomachos (*c.* A.D. 100) classed him with Zoroaster and the Babylonians.[4] Aelios Promotos (*c.* A.D. 120) in his Ἰατρικὰ φυσικὰ καὶ ἀντιπαθητικά[5] gives from his 'teacher' Ostanes a recipe for fever consisting of lead filings roasted with houseleek (ἀειζων). Tatian (A.D. 150)[6] calls Ostanes the teacher of Demokritos. The connection between Ostanes and Demokritos is not later than the I cent. A.D.,[7] and probably comes from the legend that Ostanes met the young Demokritos when the army of Xerxes visited Abdera.[8] Another story makes the Magi teach Demokritos in Babylon.[9]

In Apuleius (*c.* A.D. 180)[10] Ostanes is classed with Orpheus, Pythagoras, Epimenides, Moses, Jannes, Zoroaster, Dardanos, Apollonios [Apollobex], and other magicians. Tertullian (d. A.D. 220)[11] puts him with the magicians Typhon, Dardanos, Damigeron, Nectabis [Nektanebo], and Berenice. Tertullian's account[12] of magic (part of which is astrology) is like that in Minucius Felix (A.D. 200)[13] and St. Cyprian of Carthage (3 cent. A.D.)[14] and perhaps borrowed from them; both mention Ostanes. Lactantius (early 4 cent.) has a similar treatment of magic.[15] Hippolytos (d. A.D. 235)[16] classes Ostanes with Hermes Trismegistos, Zoroaster, Petosiris, etc.; in magic papyri[17] he is (rarely) mentioned with Apollobex, Dardanos and Damigeron.[18]

[1] Reitzenstein, (9), 70; Riess, PW, i, 1340, 1351.
[2] xxx, 1–6; Bidez, (2), ii, 11, 267, 286, 296 f. (from Apion); Preisendanz, *op. cit.* (from Hermippos); Wellmann, (5), 16 (from Bolos).
[3] Eusebios, *Praep. Evang.*, i, 10, p. 42b; v, 14, p. 202a; ed. Gaisford, Oxford, 1843, i, 93, 428; Bidez, (2), i, 173; ii, 157, 271.
[4] Bidez, (2), ii, 283.
[5] Bidez, (2), ii, 303; Diels, (3), 136: from Bolos.
[6] *Address to the Greeks*, c. 17; ANL, iii, 22.
[7] Riess, PW, i, 1340; Susemihl, i, 864.
[8] Diogenes Laertios, ix, 34; Bidez, (2), i, 167. In most cases the Demokritos associated with Ostanes was Bolos of Mendes.
[9] Vs, ii, 84 (Souidas), 94 (Hippolytos).
[10] *Apology*, xxvii, xc; (1), 274, 336; Lobeck, 235.
[11] *De anima*, c. 57; Bidez, (2), ii, 288.
[12] *De idolatria*, c. 9.
[13] *Octavius*, xxvi; Migne, PL, iii, 322; ANL, xiii, 449 ('Sosthenes' = Ostanes).
[14] *De idolorum vanitate*, cc. vi, vii; Hartel, 1868, i, 242; ANL, viii, 447; Thorndike, (1), i, 465.
[15] *Istitut.*, v, 3; Migne, PL, vi.
[16] *Refut.*, v, 14; (1), 186.
[17] PGM, i, 135.
[18] Reitzenstein, (2), 163; Salmon, DCB, iii, 920 f.

Diogenes Laertios (*c.* A.D. 225)[1] says that 'after Zoroaster came a long succession of Magi, with names such as Ostanes . . . until the conquest of the Persians by Alexander'. Wellmann[2] at first thought the Demosthenes mentioned by Aëtios (6 cent.) was Ostanes, but later[3] abandoned this view.

The older tradition (in Pliny) speaks of two Ostanes. Later tradition gives a third Ostanes, who taught Demokritos in the temple at Memphis[4] and an alchemical work[5] is attributed to him. A fourth is said to have lived in Kleopatra's time,[6] and Souidas[7] has a succession of them (*'Οστᾶναι*), a 'whole firm' as Abt says. A wall-painting in the Mithraeum at Dura-Europas in Syria (*c.* A.D. 250) shows Zoroaster and Ostanes (?), who holds an ebony stick and a book.[8] The Greek alchemical works which are attributed to Ostanes are considered later. Ostanes appears in the Arabic *Fihrist* (A.D. 987)[9] and in Arabic alchemical works.

The Magic Papyri

The Magic Papyri were written in Egypt from the 2–7 cents. and are mostly in Greek, but some are in Demotic and some in Coptic. They include older material. They contain Egyptian, Greek (mostly Stoic), Jewish, Christian and Gnostic elements. Some are single leaves with a recipe, others long books. They are on good papyrus, may contain elaborate drawings, and must have been costly, like those burnt by the Ephesian converts of St. Paul (Acts, xiv, 19). The Greek is the *κοινή* of the period, with a few peculiarities of style, and an increasing use of Jewish and Gnostic words as time goes on.[10]

The first Egyptian magic papyri to be known were bought from natives by Johann d'Anastasy (or Anastasi), Swedish vice-consul in Alexandria, in 1828. They were found in tombs, probably mostly in Thebes (one perhaps in Memphis). They were numbered by Anastasy. Several were acquired by the Leyden Museum (Ryksmuseum van Oudheden), where they were denoted by letters (V, W, X), but have since been given other designations. One (X) is a famous chemical papyrus, another part of which went to Stockholm.[11]

A preliminary account of them was given by Reuvens.[12] They were published in two parts, the second (1885) containing magic papyri and the chemical papyrus X.[13] The first study of a magic papyrus was made on the

[1] Proem., 2; Bidez, (2), ii, 268; Moulton, 410.
[2] VS, ii, 216; (6), 89.
[3] QS, 1935, iv, no. 4, 131; Bidez, (2), i, 191; ii, 305.
[4] Berthelot, (2), ii, 43; *οὐτ ἄν τις* = *'Οστάνης*, VS[6], ii, 219; Schmieder, (1), 37–8, 71, 609.
[5] Berthelot, (2), ii, 261. [6] *Ib.*, 292; Diels, (3), 127 f., 131, 134, 136.
[7] (2), ii, 659 (*Μαγοι*), 1184 (*'Οστᾶνοι*); Bidez, (2), ii, 268: *κατὰ διαδοχὴν 'Οστᾶναι*.
[8] Bidez, (2), i, 39. The stick and book suggest Mānī.
[9] Berthelot, (1), 52, 163 f.; (4), iii, 28.
[10] Dieterich, (1), (3); Festugière, *L'Idéal religieuse des Grecs et l'Évangile*, 1932, 281–328; *id.*, (1), i, 283–308; Hopfner, PW, xiv, 307, 368; Kennedy, 28, 55, 63, 162, 180; H. Leclercq, DACL, 1930, ix, 35–40; Legge, (1), i, 101, f.; E. Meyer, (2), ii, 119, 356; Nock, (1); Reitzenstein, (4), 1927, 71, 333; Scott, (2); D. Smith, *Life and Letters of St. Paul*, 1919, 232; Tarn, (1), 317; Verbeke, 321–7, 403 f.
[11] Lagercrantz, (1), 45 f.
[12] (1); K. O. Müller, *Gott. Anz.*, 1831, 545–60.
[13] Leemans, (1); Berthelot, *J. des Sav.*, 1886, 208, 222, 263; *id.*, 3–73; Dieterich, (1), (3).

British Museum XLVI (4 cent.) manuscript which was also obtained from Anastasy.[1] Two papyri in Berlin (4–5 cent.), came in 1857 from the Anastasy collection in Paris.[2] Some papyri in Paris and London were published by C. Wessely (who does not seem to have known of Goodwin's publication).[3] The London papyri were published by F. G. Kenyon.[4]

A Demotic (Egyptian) papyrus in two parts, one in London (Pap. roll 10070) and one (J 383) in Leyden, was published by F. Ll. Griffith and H. Thompson.[5] A convenient edition, with translations (and notes), of the above and other magic papyri and fragments (some Christian), over 35 items,[6] is that of Preisendanz.[7] The Coptic[8] and Christian[9] magic papyri continued the traditions. There are many Ethiopic magic texts.[10] A list of some magic papyri is given below (Preisendanz number, P):

Paris	Louvre 2391 (old Mimaut) (Greek and Coptic), P III (PGM, i, 30–63)		
	Louvre 3378, P XVI		
	BN suppl. grec 574, P IV		
London BM	XLVI (Goodwin), P V	CXXII, P VIII	CXXV, P XI*a*
	XVVII, P VI	CXXIII, P IX	CXLVII, P XI*b*
	CXXI, P VII	CXXIV, P X	CXLVIII, P XI*c*
Leyden	V (Anastasy 75), now J 384, P XII		
	W (Anastasy 76), now J 395, P XIII		
	J 383 (see above), P XIV		

The Leyden papyrus V (J 384; A.D. 300–350),[11] showing signs of use, contains magic ceremonies, the preparation of philtres, recipes for producing dreams, for bringing evil to a person, for diverting anger, etc. There is a recipe for refining gold[12] (ἴωσις χρυσοῦ) and one for ink for writing a spell on a root of pasithea or artemesia.[13] Many magic plants and stones are used, with their magic names (Decknamen) identified; e.g. serpent's blood = haematite, doctor's bones = sandstone, tears of the cynocephalus = juice of dill, etc.[14] A spell of Himerios is written on an egg with a magic ink containing plant juices, Typhon's red (ass's blood ?), quicklime, and lye (κονία). There is a recipe of Agathokles, and one of Zminios of Tentyra 'according to Ostanes'.[15] A lamp not painted with minium (ἀμίλτωτος λύχνος)[16] is specified; much use is made of lamps with materials put on the wicks.

[1] C. W. Goodwin, Fragment of a Græco-Egyptian work upon Magic, *Publications of the Cambridge Antiquarian Society*, 8° Series, 1852, No. 2 (57 pp., 1 facsim.; good notes for the date); parts tr. by C. W. King, (2), 243.

[2] G. Parthey, *Abhl. Akad. Berlin, phil.-hist. Cl.*, 1865, 109–80; Greek texts, trs. and notes.

[3] *Expositor*, 1886, iv, 194; *Denkschriften Akad. Wien, philos.-hist. Cl.*, 1888, xxxvi, II, 27–207 (London and Paris papyri); 1893, xlii, No. 2, 96 pp. (Greek texts, notes, indexes of words); *id.*, Les plus anciens monuments du Christianisme, in Graffin and Nau, 1908, iv, 95–210.

[4] *Greek Papyri in the British Museum. Catalogue with Texts*, 1893; Berthelot, *Mém. Acad. Sci.*, 1906, xlix, 222–32; *id.*, (5); U. Wilcken, *Gott. Anz.*, 1913, 716 (727–31); Bell, Nock, and N. Thompson, *Proc. Brit. Acad.*, 1931, xvii, 235–86 (BM Pap. 10588 (Demotic and Greek, prob. from Anastasy)).

[5] *The Demotic Magical Papyrus of London and Leiden*, 3 vols., 1894–9 (intr., translit., tr. and notes); summary in Lexa, i, 122 f. (Demotic Louvre pap., *ib.*, 151 f.). For magic papyri in Oslo, Eitrem, (1).

[6] Hopfner, PW, xiv, 301.

[7] PGM; he re-numbered the papyri serially.

[8] Lexa, i, 143 f.; ii, 166 f.

[9] PGM, ii, 189 f.

[10] Budge, (4); *History of Ethiopia, Nubia and Abyssinia*, 2 vols., 1928; Littmann, in Brockelmann, (2), 234.

[11] Berthelot, (1), 84 f.; (3), 8 f.; PGM, ii, 57–86; Stephanides, *Isis*, 1925, vii, 266 (ref. only).

[12] PGM, ii, 71.

[13] *Ib.*, 83.

[14] *Ib.*, 84–5.

[15] *Ib.*, 64, 66 (Zminios) — otherwise unknown magicians.

[16] *Ib.*, 66.

In a consultation of a god (θεομαντεῖον) he replies in the form of a serpent-headed god (θεὸς ὀφερπρόσωπος) and is dismissed by burning a serpent's skin.[1] Agathodaimon is a god with 'the magic name of great power';[2] other gods are Krates (Κράτης) or Chrates (Χράτης),[3] 'the great Satrap Kmēph',[4] the great god Seth (Σηίθ),[5] Abrasax or Abraxas (often occurs and 'the 365 names of the great god').[5] Jesus (Εἴσους) occurs once in a magic formula.[6] Moses (Μουσις), Solomon (Σαλαμα)[7] and Apollobēx[8] are magicians; other Jewish names are Iao (Ἰαω, not to be spoken except in cases of life or death), Sabaoth, Adonai, etc.[9] The Parthians[10] (who disappeared about A.D. 250) are mentioned.

A ring for use as a talisman contains a jasper engraved with the figure of a serpent biting its tail (Ouroboros), with the moon and two stars and the sun above, and the name Abraxas.[11] The seven vowels (α ε η ι ο υ ω) and the number 7, 'the number of letters in the name of god (Iao) following the harmony of the seven tones'[12] stand for the seven planets.[13] The number 4 (directions, winds, elements)[14] suggests the gnostic Markos (see p. 268).[15] There are many unintelligible magic words and vowels. The papyrus contains a 'sphere of Demokritos' (see p. 41).[16]

The Leyden Papyrus W (Anastasy 76), now J 395 (A.D. 346)[17] is in two parts of similar content, joined into a continuous text by Dieterich.[18] Preisendanz and others[19] think they are separate texts. It begins with the title 'The Divine Book called the Monas or the Eighth [Book] of Moses (Βίβλος ἱερὰ ἐπικαλουμένη Μονὰς ἢ 'Ογδόη Μοϋσέως)', quotes the book of Moses on archangels (ἐν τῇ 'Αρχαγγελικῇ),[20] a 'Key' (Κλείς),[21] and a secret tenth book of Moses (Μοϋσέως ἀπόκρυφος ἡ Δεκάτη),[22] and is full of Jewish material.[23] It quotes the fifth book of the *Ptolemaïka Panaretos* (τῶν Πτολεμαϊκων ἐπιγαφομένη Παναρέτος), entitled *One and the All* (ἓν καὶ τὸ πᾶν), which deals with spirits of fire and darkness and contains magic names and vowels.[24] It mentions Demokritos, Ostanes, Apollobex, Bitys, Agathodaimon, Christ, Erōtylos in the Orphics, Hiëros, Euēnos, Zoroaster, and Pyrrhos,[25] and includes what it calls the *Kosmopoiïa* (Κοσμοποιΐα) of Abrasax, involving the creation of seven gods by the seven-fold laugh of Hermes (see p. 239).[26] The number 7 appears often, also the number 4, including a rectangular diagram with the four

[1] *Ib.*, 68. [2] *Ib.*, 67. [3] *Ib.*, 73. [4] *Ib.*, 70.
[5] *Ib.*, 67. [6] *Ib.*, 71, 83. [7] *Ib.*, 62.
[8] *Ib.*, 66; a Coptic magician in Pliny, xxx, 2.
[9] PGM, ii, 68. [10] *Ib.*, 76.
[11] *Ib.*, 71; gnostic amulets with this figure are known. [12] *Ib.*, 75.
[13] Hopfner, (1), 213; from Nikomachos. [14] PGM, ii, 74.
[15] Reuvens, (1), 1e Lettre, 26 f., 47 (Pythagorean); Berthelot, (1), 34; (3), 9.
[16] PGM, ii, 81.
[17] Reuvens, (1), Appendice, 152 f.; Berthelot, (3), 16–19; PGM, ii, 86–131.
[18] (1), 3–20, 62, 70, 195; (3).
[19] Festugière, (1), i, 300–3; Reitzenstein, (6).
[20] PGM, ii, 128. [21] *Ib.*, 108. [22] *Ib.*, 131.
[23] Dieterich, (1), 70, 137, 141, 155, 161, 169; (3), 755, 758. The use of the key (κλείς) in magic ceremonies is old in Greece; it appears also in Orphic and Gnostic works, and the Christian doctrine that Peter held the keys of heaven appeared about A.D. 300; Festugière, (1), i, 342; Kohl, PW, xi, 597; Kroll, PW, viii, 792 f.; E. Meyer, (2), ii, 119 f.
[24] Dieterich, (1), 203; PGM, ii, 128; Berthelot, (3), 16, quotes from Scaliger's ed. of Manilius, 209, on a similar work attributed to Hermes Trismegistos on the 7 planets: *οἱ ἑπτὰ κλῆροι ἐν τῇ Παναρέτῳ Τρισμεγίστου.*
[25] PGM, ii, 102, 128. [26] *Ib.*, 95; Festugière, (1), i, 360 f.

directions (north, south, etc.), the 'elements' heaven (fire ?), air, and earth (water is missing), and the invocation of the four winds; also it contains magic vowels (α ε η ι ο υ ω) arranged in a peculiar way as the 'wings of Hermes (Ἑρμου πτέρυξ)':[1]

ω ω
ο ο
ω υ υ ω
ο ι ι ο
ω υ η η υ ω
ο ι ε ε ι ο
ω υ η α η υ ω
ο ι ε ε ι ο
ω υ η η υ ω
ο ι ι ο
ω υ υ ω
ο ο
ω ω

α
ε ε
η η η
ι ι ι ι
ο ο ο ο
υ υ υ υ υ
ω ω ω ω ω ω

In a recipe from a book of Manetho the seven flowers of the seven stars (marjoram, lily, lotus, ερεφύλλινον (meaning unknown), narcissus, snowdrop, and rose) are ground in a white mortar and dried in the shade for 21 days; the preparation is used to paint the 'great name' (Iao) of seven letters (αεηιουω) on a square tablet of soda (νίτρον τετράγωνον).[2] This could also be painted on both sides with an ink of seven flowers and seven perfumes which are related to the seven planets (styrax = Kronos-Saturn, betel = Zeus-Jupiter, costus = Ares-Mars, incense = Helios-Sun, Indian nard = Aprodite-Venus, frankincense = Hermes-Mercury, myrrh = Selene-Moon).[3] The tablet is to be licked on one side and the writing washed off the other side with a mixture of the milk of a black cow and wine unmixed with sea-water.[4] One spell is to extinguish fire, another to keep it burning.[5] Inside a hollow model of a crocodile in red wax are put gold, silver, and 'ballatha of the Jews' (τὸ καλούμενον βαλλαθὰ τὸ τῶν Ἰουδαίων).[6]

The Great Paris Magic Papyrus (BN Suppl. grec 574), *c.* A.D. 300, 36 leaves written on both sides,[7] says the sword of Dardanos (ξίφος Δαρδάνου), to which nothing is equal in action (ἐνέργειαν), is made by taking a 'breathing magnet stone (λίθον μάγνητα τὸν πνέοντα)' and engraving on it figures of Aprodite, Psyche and Eros (who burns Psyche with a torch), also seven letters σ and seven letters η. It is put under the tongue and a spell pronounced. A spell is written on a gold leaf (called a 'sword'), and given to a cock partridge, which is killed, and the leaf taken out and hung from the neck. Incense

[1] Dieterich, (1), 185, 199; Dornseiff, 44, 58 f., 64; PGM, ii, 124; Preisendanz, *A. Rel.*, xvi, 553; Reuvens, (1), Appendice, 157.

[2] PGM, ii, 89, 109.

[3] *Ib.*, 88, 93.

[4] *Ib.*, 93, 118; Berthelot, (3), 18, thought the tablet was gypsum, calcite, or felspar (from the shape).

[5] PGM, ii, 102–3.

[6] *Ib.*, 103; iron or steel ?, Dieterich, (1), 191.

[7] PGM, i, 64–180; C. Bonner, *Classical Philology*, 1930, xxv, 180–3.

is made from 4 drachms (δραχμαὶ) each of incense (μάννα), styrax, poppy juice (ὀπίον), and of myrrh, half a drachm each of frankincense (λίβανος), saffron, and bdellium, mixed with fatty spurge juice (ἰσχάδα λιπαρὰν), and to all is added an equal part of fragrant wine.[1] A spell of King Ostanes to Pitys (Πίτους ἀγωγή)[2] is to be written on hieratic paper with 'the ink given you', viz. a mixture of serpent's blood and goldsmith's soot (αἰθάλη χρυσοχοϊκή).[3] In questioning a corpse by 'the Thessaler Pitys' a spell of 12 letters is written on a flax leaf with ink of minium, burnt myrrh, and juices of fresh wormwood, houseleek, and flax, and this is put in the mouth of the corpse.[4] Among Jewish material is a tested (δόκιμον) recipe of Pibēchiōs (Πιβήχεως) for writing a spell on a plate of tin, which is hung on a person to expel a demon.[5] Bitys (Πίτους),[6] Ostanes,[7] and Ereschigal[8] are named. The so-called *Mithrasliturgie*[9] is in this papyrus.

The Berlin (Parthey) papyri 5025A (4–5 cents.)[10] and 5026 (4 cent.)[11] mention milk of a black cow,[12] the serpent Ouroboros,[13] and pills to produce invisibility;[14] and the plant aglaophotis, said to be the rose.[15] The materials are mostly vegetable (laurel leaves frequently) and animal, but also the magnet (λίθος πνέος),[16] an unpainted lamp (λύχνος ἀμίλτωνος)[17] and virgin earth (παρθένος γῆ),[17] Abraxas, Mithra, Sabaoth, Adonai and Platha are named.

The London papyrus BM XLVI (4 cent.)[18] refers to alternative magic books (ἐν δὲ ἄλλοις)[19] and mentions painting one eye with Coptic στίμι.[20] Vowels are arranged in triangles.[21] A magic ring (κρίκος) with 59 magic characters is fixed to a lead plate and covered with plaster (γύψισον).[22] An image of Hermes, made from 28 laurel leaves, virgin earth, contents of an ibis egg, seeds of wormwood, and cynocephalus grass, is put in a chapel for invoking dreams.[23] An image of Sarapis is engraved on a jasper (ἰασπαχάτος λίθος) to set in a ring.[24] The Egyptian incense *kyphi* (κοιφι)[25] and the green stone καλλάινος are specified.[26]

A headless god (Ἀκέφαλος) is invoked[27] and is shown (with five feet projecting from the neck) in Berlin papyrus 5026;[28] it probably represents Osiris decapitated by Seth.[29]

Papyrus BM CXXI (3–4 cent.),[30] 7 ft. 8 in. long and 13 in. high, with some fragments, begins with 216 single lines of Homer, to be used for drawing lots (Ὁμηρομαντία), and a list of times of the day, favourable for divination on each day of the month. It then gives the Παίγνια of Demokritos (Bolos)[31]

[1] PGM, i, 127–9.
[2] *Ib.*, 132.
[3] *Ib.*, 134–5.
[4] *Ib.*, 139.
[5] *Ib.*, i, 170.
[6] *Ib.*, 132, etc.
[7] *Ib.*, 135.
[8] *Ib.*, 120; Babylonian, Meissner, ii, 145.
[9] Dieterich, (2); Reitzenstein, (4), 1927, 169 f. (text 174–6); PGM, i, 88 f.
[10] PMG, i, 1–18.
[11] *Ib.*, i, 18–30.
[12] *Ib.*, i, 2.
[13] *Ib.*, i, 10.
[14] *Ib.*, i, 12.
[15] *Ib.*, i, 14.
[16] *Ib.*, i, 22.
[17] *Ib.*, i, 24.
[18] Goodwin; Kenyon, 64–81; PGM, i, 180–98.
[19] PGM, i, 182.
[20] *Ib.*, i, 182.
[21] *Ib.*, i, 184; with a picture of the *utchat* or eye of Osiris, Plate III, Fig. 5.
[22] *Ib.*, i, 192; Plate III, Fig. 6.
[23] *Ib.*, i, 194.
[24] *Ib.*, i, 196.
[25] Partington, (1), 167–70.
[26] Kenyon, 71–2; green was an important colour in magic.
[27] Kenyon, 68; PGM, i, 184.
[28] PGM, i, 31; Plate I, Fig. 2.
[29] Preisendanz, Akephalos der kopflosen Gott, *Beih. a. O.*, 1926, viii, 1–80, 3 plates.
[30] Kenyan, 83–115; PGM, ii, 1–45.
[31] Kenyon, 89; PGM, ii, 7.

(see p. 212), followed by recipes, e.g. a philtre containing ammoniac salt (ἁλὸς ἀμμωνιακοῦ), Attic honey, and boar's gall (χολῆς κάπρου), to be applied *in situ* (τὴν βάλανον), and a number of charms to be written or spoken.[1] A magic ink is made from minium, blood of a white dove and a crane, juices of sycamore and artemesia, cinnabar (κιννάβαρι) and rain water.[2] The papyrus contains a great number of symbols and some magic diagrams (Fig. 6).[3] The

FIG. 6.

8-rayed star in lines 3 and 4 resembles the symbol of alum or arsenic which occurred in the Greek chemical MSS. but the latter has no small circles on the rays. Lines of symbols[4] are similar to the 'symbol of the crab' in a chemical MS. (one symbol is the same).[5] Planetary symbols are used in the papyri only for the metals gold and silver; the symbol for mercury denotes the planet or the god Hermes.[6]

In Papyrus BM CXXI there is a triangle inside a square, with magic letters;[7] a bird inside four circles of letters;[8] a square with diagonals, resting on a serpent and with two animal heads above;[9] and the serpent ouroboros (οὐροβόρος), a snake with a lion's head biting its tail, and formed of three concentric circles, as in many of the alchemical manuscripts but without feet.[10] A salve is made from a crushed fly and Coptic στίμι.[11] There are magic lamps,[12] a sign for scratching on the hoof of a race-horse, and a spell for scratching on a lead plate made from water-piping[13] with a bronze needle, or on gold, silver, or tin plates,[14] fumigation with sulphur and Nile mud;[15] a diadem of Moses is a spell.[16] Pythagoras and Demokritos are quoted for astrological divination in dreams,[17] Klaudianos for a book on prayers to the Moon,[18] and Hermes for a spell to be written on a gold plate.[19]

[1] Kenyon, 180; PGM, ii, 8 f.
[2] Kenyon, 91; PGM, ii, 10.
[3] Kenyon, 90, 91, 97.
[4] Kenyon, 90, 97, 99, 111.
[5] Berthelot, (5), 229 f.
[6] Kenyon, 79, etc.
[7] PGM, Plate I, Fig. 1.
[8] *Ib.*, Fig. 2; Kenyon, Plate 55.
[9] PGM, Fig. 3.
[10] *Ib.*, 26, Plate I, Fig. 4; Kenyon, 103, Plate 59; Berthelot, (5), 229 f.; it is also shown on the Egyptian Piankhy stele, Griffith, (1), 22.
[11] Kenyon, 95; PGM, ii, 15.
[12] Kenyon, 96, 101–3; PGM, ii, 16 f., 24, 27.
[13] Kenyon, 97 f.; PGM, ii, 18, 20.
[14] Kenyon, 99, 108; PGM, ii, 26, 33.
[15] Kenyon, 100, 102; PGM, ii, 22.
[16] Kenyon, 104; PGM, ii, 28.
[17] Kenyon, 109; PGM, ii, 35.
[18] Kenyon, 111; PGM, ii, 38.
[19] Kenyon, 113; PGM, ii, 40.

Papyrus BM CXXII (4–5 cent.) mentions Abrasax as 'the number of days in the year' (365) and has a grotesque picture of the god Bes (Βησας) with a crown, a sword pointed towards his head, and a magic wand consisting of a forked stick. The 'headless god with his face on his feet' is invoked.[1] Papyrus BM CXXIII (4–5 cent.) invokes the god Βαινχωωωχ.[2] Papyrus BM CXXIV (4–5 cent.) has diagrams of a gold/silver plate engraved with magic names (Ablanathanalba, Abrasax, etc.).[3] Papyrus BM CXXV (5 cent.)[4] has a 'tested (δεδοκίμασται)' spell of 'an old serving woman of Apollonios of Tyana' which evokes a goddess and turns her into the appearance of an old woman.

Many Greek magic works are called 'Egyptian' but a Demotic (Egyptian) papyrus says the words of a spell must be in Greek.[5] Some old Egyptian material includes a 'fluid' captured from the gods and transferred to material objects, e.g. parts of the human body. The word *οὐσία* was used for a skull, bone, or earth from a grave.[6] The spells must be kept secret.[7] The word *κοινά* means 'as usual', and *ἄλλος* stands for an alternative recipe or procedure; *δίωκε τὸν λόγον* means 'pursue the recital of the formula'.[8] The papyri abound in magic names,[9] some reminiscent of Egyptian or Persian.[10] There are Babylonian names: Ereschigal, Shamash (*Σαμας*) and *Νεβουθ* (Nebo).[11] Hebrew names are plentiful; *Αβλαναθαναλβα*[12] perhaps means 'Father, come to us'. The name of the Egyptian god *Βαινχωωωχ*[13] is supposed to mean 'soul of darkness'[14] and is also contained in a spell given by Alexander of Tralles (6 cent.).[15] Thoth-Hermes is called in a Paris papyrus 'first leader of all magicians (*πάντων μάγων ἀρχηγέτης*)'.[16] Several gods could be invoked by a 'great spell (*ἐντυχία*)'.[17] A 'triple god (*τριμορφε θεος*)' is named on an amulet.[18]

The chief evil power was Seth-Typhon but many other demons are named.[19] The 'name of a hundred letters' is that of Hermes, written in a circle and the same when read both ways.[20] Directions for the correct pronunciation and intonation of magic words are given and they must be spoken at the correct time.[21] Some may have had magic numerical values. The magic words are plentifully filled out with vowels,[22] the importance of which was recognised

[1] Kenyon, 115–20; PGM, ii, 45–50; Plate I, Fig. 4.
[2] Kenyon, 120; PGM, ii, 50–1.
[3] Kenyon, 121–3; PGM, ii, 52–3, Plate I, Fig. 5.
[4] Kenyon, 123–5; PGM, ii, 54–5.
[5] Dieterich, (1), 1891, 155.
[6] Erman, (1), 209 f.; Hopfner, (3), 1921, 209 f.; *id.*, PW, xiv, 301 f.; Nock, (1), 228 f.; Scott, (2), 113 f.; Verbeke, 321–37, 403 f.
[7] Festugière, (1), i, 351.
[8] Kenyon, 78.
[9] List in Kenyon, 255–67.
[10] Dieterich, (1), 39; (2), 36 f.
[11] Kenyon, 66, 79, 80; PGM, i, 120.
[12] Kenyon, 80.
[13] Kenyon, 65, 94, 97, 102, 121, 123.
[14] Hopfner, PW, xiv, 3403; *id.*, *Arch. Orient.*, 1931, iii, 119 f.
[15] *De arte medica*, xi; *Med. Art. Princ.*, i, 313; *baynchoog* with other magic words.
[16] Pfister, PW, Suppl. iv, 323 f., 337, 339.
[17] Dieterich, (1), 159.
[18] Gressmann, (1), 51.
[19] Eitrem, (1), 33; Hopfner, (1), 255; E. Peterson, *Rhein. Mus.*, 1926, lxxv, 393–421.
[20] BM XLVI; Kenyon, 75, 79; King, (2), 243, 362; PGM, i, 196, Plate III, 6.
[21] Gressmann, (2), 20; R. Heim, Incantamenta magica in *Jahrb. f. Philol.*, 1893, Suppl. xix, 463–576; Hopfner, (3), 1921, 173–88; *id.*, (1), 251–5; *id.*, PW, xiv, 334 f.; Kenyon, 66; Kuhnert, PW, v, 2771; E. Meyer, (2), ii, 103, 360, 417.
[22] Dieterich, (2), 28, 32 f., 65; Reitzenstein, (2), 263 f.

by Pythagoras.[1] The name Ἰαώ was powerful because it is composed of the first three vowels in the set ιαωουηε denoting the 7 spheres or planets.[2]

The materials specified in the papyri[3] are largely plants (βοτάναι), probably derived from Greek magic;[4] animals, characteristic of Egyptian magic,[5] and some stones and metals probably derived from Babylonian magic.[6] Metals, including iron, were used.[7] The plants must be genuine (tests are given), and they are related to gods, from which (as in old Egyptian texts) they are said to be emanations.[8] Various kinds of apparatus were used, some made of specified metals.[9] A relation of the magic papyri to alchemy[10] is, however, not very close; both the chemical papyrus X and the Greek chemical treatises are notably non-magical.

The magic operations mostly contain three elements: an act (ποίησις or πρᾶξις), a prayer or formula of invocation (λόγος or πλῆσις), and a recipe or spell (ἐπῳδή) for divination of a theurgic or magic character.[11] The prayers to gods found in some papyri[12] were probably merely copied out by the magician for use as spells.[13] Relations with Hermetism[14] and Neoplatonism[15] are probably slight.[16]

The divine force (δύναμις, ἐνεργεια, πνεῦμα, χάρις, δόξα) consisted of material emanations (ἀπόρροια) from a god,[17] and could animate material objects, such as amulets, which go back to early times in Egypt.[18] The 'stone of tin' with seven 'eyes' (representing the planets) in Zechariah (iv, 10) is the ring

[1] Boll, PW, vi, 2409; Dornseiff, 33.

[2] Arendzen, CE, vi, 597; Budge, (4), 204; Dieterich, (1), 22, 41, 47, 178, 185, 199, 201; Dombart, PW, II Reihe, ii, 317, 1582; Fluss, *ib.*, 1999; Hopfner, (1), 213; PGM, ii, 127; Reitzenstein, (5), 172, 175, 181, 191, 244.

[3] Hopfner, (3), 1921, 209 f.; Hubert, DS, III, ii, 1506 f.

[4] Pfister, PW, xix, 1446.

[5] The windpipe of a goose (as in Hippolytos) was used; Kenyon, 77.

[6] Hopfner, PW, xiv, 315 f., 319, 323, 326; list of animals in Thorndike, (1), i, 67 f. (from Pliny); list of names of materials, Kenyon, 267–96.

[7] Hubert, DS, III, ii, 1507 f.; Pliny, xxviii, 17.

[8] Abt, 86, 112, 140; Gubernatis, i, 218 f.; Hopfner, *Arch. Orient.*, 1931, iii, 327 (329, 331); *id.*, (1), 240; *id.*, PW, xiv, 320; Lenz, (2), 193; Lexa, i, 122; ii, 65; Pfister, PW, xix, 1446 (ῥιζοτόμοι); Thorndike, (1), i, 64 f.

[9] Dieterich, (1), 157 f., 159–60; Hopfner, PW, xiv, 327.

[10] Berthelot, (1), 21 f., 44, 57, 83; (3), 8 f.; (5), 222 f., 229; Reuvens, (1), 1e Lettre, 10, 52; 3e Lettre, 65 f.

[11] Festugière, (1), i, 283–4.

[12] Reitzenstein, (2), 1904, 30, 78.

[13] Festugière, (1), i, 285; E. Meyer, (2), ii, 120.

[14] Reitzenstein, (2), 14; (4), 1927, 284 f.

[15] Eitrem, (2); Festugière, (1), i, 288; Kenyon, 107; Nock, (1), 229; PGM, ii, 88.

[16] Hopfner, PW, xiv, 311.

[17] Wetter, 156.

[18] Blau, JE, i, 546; C. Bonner, *University of Michigan Studies. Humanistic Series*, Ann Arbor, 1950, xlix; *id.*, *Hesperis*, 1951, xx, 301–45; H. Bonnet, 26; Budge, (2), 25; *id.*, (4); *id.*, *History of Ethiopia*, 1928, ii, 581 f.; Carra de Vaux, *E. Isl.*, ii, 243; Flather, DA, i, 118 (materials); Ganszyniec, PW, xii, 1887 (gems); B. Heller, *E. Jud.*, ii, 737; Hopfner, PW, xiv, 314; Labatut, DS, i, 252 (materials); Pfister, HDA, i, 374–84; Reitzenstein, (2), 291; Siebs, HDA, iii, 590 (593); H. A. Winkler, *Islam*, 1930, Beih. vii, no. 4 (pp. 176, 3 plates). The word *amuletum* occurs in Pliny, xxix, 19. Derivations from Latin *amolire* (avert) and Arabic *ḥimālat* (carried on the person) are doubtful: LS, 113; Pfister, HDA, i, 374; Riess, PW, i, 1984; Weinreich, *A. Rel.*, 1931, xxix, 258. Samaritan amulets: Budge, (4), 258 f., 271; Gaster, *British Academy Schweich Lecture* (1923), 1925, 81, 149. The pentacle (πένταλφα), much older than the hexagon, is of Babylonian origin; it appears on Syriac and Arabic amulets, but the latter emphasise the number 7: Budge, (4), 40 f., 281, 431 f.; Eisenstein, JE, ix, 160; Eisler, (1), 302, 332; Karppe, 283. For magic rings, usually having engraved characters, see Eitrem, (1), 34; Gressmann, (2), 21; Hopfner, PW, xiii, 762; Josephus, *Ant.*, VIII, ii, 5; Marshall, and Ganschinietz, PW, II Reihe, i, 807, 833.

of the Babylonian god Marduk. Amulets with squares of letters giving the same words when read in different directions appear in 8-cent. Coptic papyri.[1] Amulets were worn to counteract the evil eye (βασκανία; *fascinum*).[2]

[1] *Führer durch die Ausstellung Papyrus Erzherzog Rainer*, Vienna, 1894, 56; see also Darmstaedter, *Isis*, 1932, xviii, 322; Davis, *ib.*, 1932, xx, 578; Sarton, *ib.*, 1935, xxiv, 107; 1950, xli, 198.

[2] Blau, JE, v, 280; Budge, (4), 354; Erman, (1), 311 (unknown in Egypt in New Kingdom); J. Harrison, 191; O. Jahn, *Sitzb. Ges. Wiss. Leipzig, Phil.-hist. Kl.*, 1855, vii, 28–110 (plates); C. W. King, (2), 195; Maury, (1), ii, 506; Preuss, *A. Rel.*, 1910, xiii, 453; Seligmann, (1), (2), HDA, i, 679.

CHAPTER XV

ASTROLOGY

The relations of magic and astrology to early alchemy are only slight.[1] The home of astrology was ancient Babylonia, where planets were early associated with divine beings. Some 4000 astrological cuneiform texts, copied from older texts for Ashurbanipal (668–626 B.C.), are in the British Museum. The Chaldaeans are properly the later inhabitants of South Babylonia (the Kaldu or Kalda), but for Hellenistic authors 'Chaldaean' may mean Persian as well as Babylonian, and for the Romans every astrologer was a 'Chaldaean'.[2]

The Babylonians assumed that the planetary gods rule absolutely over human destiny; the stars move according to fixed laws and events in the sidereal world are reproduced on earth.[3] The Neoplatonists (see p. 225) taught that the planets indicate but do not determine events.[4] Babylonian astrology reached Persia after the conquest of Babylon by Cyrus in 539 B.C. The Greeks became acquainted with it in the Persian wars in the 5 cent. B.C.; their interest in it is shown by the large number of Greek astrological texts.[5]

'Chaldaean' astrology (Babylonian modified in Persia) reached Egypt at least as early as 150 B.C., where it was attributed to a mythical Egyptian king Nechepso and his priest Petosiris; it spread, partly into Greece, from Alexandria as a secondary source; its flourishing period in Greece was in the 2 cent. B.C.[6] Hellenistic Egyptian astrologers were probably priests using Egyptian books.[7] Petosiris was a high-priest of Thoth in Hermopolis, *c.*

[1] Bidez, (2), i, 131–42; F. Boll, (1)–(5); Bouché Leclercq, (1); Cumont, (1), (2), (5); R. Eisler, *The Royal Art of Astrology*, 1946; Festugière, (1), i, 89–186; W. Gundel, Astronomie, etc., *Bursian's Jahresbericht*, 1934, ccxliii, II, 1–162; *id.*, PW, II Reihe, iii, 2419–39; *id.*, RAC, i, 813–31; Hallopeau, *Rev. gén. Sci.*, 1918, xxix, 246; Lippmann, (2), i, 202–20; Martin, DS, i, 476; M. P. Nilsson, The Rise of Astrology in the Hellenistic Age, in *Meddelande från Lunds Astronomiska Observatarium*, 1943, ser. II, No. iii (Greek influence); Riess, PW, ii, 1802–28; Thorndike, (1), i–vi; var. authors, ERE, xii, 48–101; E. Zinner, *Die Geschichte der Sternkunde von den ersten Anfängen bis zur Gegenwart*, 1931.

[2] Boll, (1), 337; *id.*, (3), 1 f.; Bouché Leclercq, (1), 546; Friedländer, i, 133, 367; Gressmann, (2), 1 f.; M. Jastrow, *Die Religionen Babyloniens und Assyriens*, Giessen, 1912, II, i, 425; V. E. Johnson, *Chaldean Science*, 1890; F. X. Kugler, *Im Bannkreis Babels*, Münster, 1910, 102 f., 116; Maspero, (2), 647 f., 674 f.; Meissner, i, 312; ii, 10 f., 132, 293 f., 404, 411, 414; Riess, PW, ii, 1802–28; E. Schrader, *Die Keilschriften und das Alte Testament*, 3 ed. (with H. Zimmern and H. Winckler), 1903, 361 f., 412, 420 f.

[3] Meissner, ii, 125, 163.

[4] Bouché Leclercq, (1), 508 f., 599 f.

[5] *Catalogus Codicum Astrologorum Graecorum*, ed. Cumont, etc., Brussels, 1898 f.; Delatte, (1), 129–271.

[6] Albright, 262; Bouché Leclercq, (1), 36; Canney, ERE, xii, 80 (Jews); Festugière, (1), i, 88 f., 92 f., 102 f., 115 f.; Gressmann, (2); E. Meyer, (2), ii, 54; M. Uhlemann, *Grundzüge der Astronomie und Astrologie der Alten, besonders der Ägypter*, Leipzig, 1857; A. Ungnad, ZDMG, 1923, lxxvii, 81 (Hittite intermediaries ?).

[7] Cumont, (5), 74, 134, 154 f., 160 f., 202.

350 B.C.; his tomb was excavated.[1] Petosiris and Nechepso were probably the same person.[2] The work ascribed to them[3] is a combination of Babylonian and Egyptian astrology probably composed about 150 B.C. Petosiris is mentioned by Juvenal (A.D. 100)[4] and Hippolytos,[5] and Nechepso by Galen (see p. 192).[6] A spurious book on astrology (Ἀποτελεσματικά) is attributed to the Egyptian high-priest in Heliopolis and historian of Egypt Manetho (fl. 280 B.C.). A book by him on the sacred Egyptian incense (κῦφι) is quoted by Plutarch, Galen, and Souidas;[7] a spurious medical work by Manetho, Nechepso and Cleopatra exists in MS., and Paul of Aegina says Manetho invented a xerion (ξηρίον) or dusting powder, made from burnt wine yeast (διὰ σφέκλης).[8]

The number 7 had a magic significance in Egypt from an early period,[9] but the 7 planets are not Egyptian. The identification of the morning and the evening star as a single planet (Venus), and the inclusion of the sun and moon to make up the number 7, appeared in Babylonia, probably not before the 7 cent. B.C.[10] The 7 planetary gods, and their relation to heavens, spheres, colours, metals, etc., appear in Jewish, Orphic, Hermetic and Gnostic works.[11]

The 'Egyptian' order of the planets is: Saturn, Jupiter, Mars, Venus, Mercury, Sun, Moon. The 'Chaldaean' order is: Saturn, Jupiter, Mars, Sun, Venus, Moon. The Leyden Papyrus W (J 395)[12] has a list of days of the week named after Greek gods and the Greek names of the corresponding planetary gods in the 'Egyptian' order, which is also given by Cassius Dio (d. A.D. 235)[13] with two explanations for the names of the days of the planetary week, one of which is probably correct. It was related to an obscure 'musical harmony' (διὰ τεσσάρων), and the same account is given by Vettius Valens (2 cent. A.D.)[14] and by al-Khwārizmī (d. A.D. 850).[15]

The first Roman work on astrology (composed A.D. 9–22) is that of Manilius.[16] He avoids the 'Chaldaean' name *planeta*, but he gives the five planets in the order of Poseidonios[17] and distinguishes their sexes.[18] Vettius Valens (2 cent. A.D.) wrote an Ἀστρολογούμενα containing Egyptian elements[19] and dealing with Iatromathematics (see p. 245). Greek astrology was codified by Ptolemy (Ptolemaios), perhaps born at Ptolemaïs in Egypt, who lived in

[1] W. Spiegelberg, *Sitzb. Heidelberg Akad., Phil.-hist. Kl.*, 1922, no. 3; E. Suys, *Vie de Petosiris, grand-prêtre de Thot à Hermopolis la grande*, Brussels, 1927.
[2] Albright, 262; Boll, (3), 96; Bouché Leclercq, (1), 230, 464, 530, 563 f.; Darmstadt, q. in *A. Rel.*, 1922, xxi, 481; Kroll, PW, xix, 1165; Kroll and Pieper, PW, xvi, 2160.
[3] Fragm. in Riess, *Philologus Suppl.*, 1891, v, 325–94.
[4] *Sat.*, vi, 581.
[5] *Refut.*, v, 14; (1), 186; with Ostanes, Hermes Trismegistos, Zoroaster, etc.
[6] Kühn, xii, 207.
[7] FHG, ii, 511.
[8] Kind, PW, xiv, 1101; Schmitz, DBM, ii, 915.
[9] Erman, (1), 31, 148, 153, 310 f.
[10] Boll, PW, vii, 2553; Bouché Leclercq, 41; Nöldeke, *A. Rel.*, vii, 344.
[11] Dieterich, (1), 24, 44–7, 151; Eisler, (1), 206; (3), 353 f.; M. R. James, (1), 43 (*Protevangelium of James*, A.D. 150).
[12] Dieterich, (1), 41 f.
[13] *Hist.*, xxxvii, 17 f.
[14] Boll, PW, vii, 2547–78; Bouché Leclercq, (1), 479; Chwolsohn, ii, 173; Jeremias, 164.
[15] E. Wiedemann, *Sitzb. Erl.*, 1915, xlvii, 235.
[16] *Astronomicon libri quinque*, ed. Breiter, 2 vols., Leipzig (Teubner), 1907–8; ed. van Wageningen, Leipzig (Teubner) ——, 1915; *id.*, PW, xiv, 1115 f.
[17] Ed. Breiter, i, 22, 27; ii, 24, 33.
[18] *Ib.*, ii, 49, 58, 67.
[19] *Anthologiarum Libri*, ed. W. Kroll, Berlin, 1908 (text); Boll, (1), 213, 374; Kroll, PW, ix, 802; Riess, PW, i², 1802 f.

Alexandria; his first and last recorded astronomical observations are in A.D. 127 and 151. Besides a work on astronomy he wrote an astrological *Tetrabiblos Syntaxis*, which contains nothing on alchemy.[1] Aulus Gellius (A.D. 123–65)[2] and Artemidoros (A.D. 135–200)[3] accepted planetary influences.

Julius Firmicus Maternus wrote (A.D. 334–7) a work on astrology in eight books[4] and (A.D. 346–7) a Christian work giving information on every form of idolatry known, including Mithraism.[5] The *Mathesis* gives the kind of people born under various planets: those born under Mercury are often gold workers and also 'masters of certain concealed arts',[6] those born under Saturn were magicians and also had knowledge of 'secret and concealed arts',[7] those under the Moon made false coin and gems 'painted with all kinds of colours'.[8]

Demokritos (see p. 40) wrote a (lost) work on the planets (περὶ τῶν πλανήτων) and was the first to use this name, probably under Babylonian influence. Bolos of Mendes (see p. 211) wrote on star signs (περὶ σημείων).[9] The Pythagoreans were also acquainted with Oriental beliefs. Philolaos (see p. 11), Ptolemaios, and Vettius Valens (2 cent. A.D.), counted five planets (the sun and moon being separate);[10] Diodoros Siculus[11] said this number probably goes back to the Chaldaeans. Perhaps through Archytas of Tarentum (d. 360 B.C.), Chaldaean astrology was known to Euripides (*c.* 450 B.C.)[12] and to Plato, for whom the planets were divine living beings (σώματα ἔμψυχα) describing circular orbits; in his last work, *Epinomis* (see p. 67), he shows a good knowledge of the subject. The divine nature of the planets was fundamental in astrology; Iamblichos (d. A.D. 330) called the planets 'visible gods (θεοὶ φανεροί)', acting by 'sympathy' on the universe, which is a 'great animal (ἓν ζῶόν ἐστι τὸ πᾶν)'.[13] Salmasius[14] said: aut astra dii sunt, aut nulla est astrologia (either the stars are gods or there is no astrology).

The Stoics were greatly influenced by astrology from the beginning; the Babylonian 'correspondence' became the Stoic 'sympathy', now a moral destiny or providence. The Epicureans rejected astrology. The criticisms of Carneades led Panaitios to remove it from the Stoic system, but it was revived by Poseidonios (135–51 B.C.; see p. 163).[15] Astrology was opposed by

[1] A. de Morgan, DBM, ii, 569; Kopp, (2), i, 48; Schmidt, in Christ, 1913, II, ii, 712 Thorndike, (1), i, 105.

[2] *Noctes Atticae*, iii, 10; xiv, 1.

[3] *Oneirokritika*, ii, 38 (ed. 1603).

[4] *Mathesis*, ed. W. Kroll and F. Skutsch, 2 vols., Leipzig (Teubner), 1897, 1913; Riess, PW, ii, 1841; Thorndike, (1), i, 525–37.

[5] *De Errore Profanorum Religionen*, ed. K. Ziegler, Leipzig (Teubner), 1907; ed. and tr. G. Heuten, Brussels, 1938 (*Trav. Fac. Philos et Lettres, Univ. Bruxelles*, viii, 213 pp.), 6 (date), 18 f. (sources Loukian and Cornelius Labeo), 28 (unique Vatican MS.), 40–127 (text and tr.), 129–211 (comment., index).

[6] Kroll and Skutsch, i, 158; Borrichius, (2), 75, thought *aurifices* were alchemists; Kopp, (2), i, 44.

[7] Kroll and Skutsch, i, 99, 101 f.

[8] *Ib.*, i, 215, 220, 227, 230; ii, 260.

[9] Riess, PW, ii, 1802 f.

[10] Bouché Leclercq, (1), 68, 89, 509, 568, 573; J. Kroll, (1), 119, 178.

[11] ii, 30.

[12] Riess, PW, ii, 1810.

[13] Parthey, (3), 55, 137, 164, 195, 217; Kroll, PW, ix, 650.

[14] (4), 795.

[15] Boll, (3), 89 f.; *id.*, PW, vii, 2565; Capelle, *Hermes*, 1925, lx, 373–95; Frank, 27–46, 88 f.; 105 f., 197, 201 f.; Gressmann, (2), 7 f.; Kerényi, *A. Rel.*, 1925, xxii, 245; Riess, PW, ii, 1802 f.; Stemplinger, 94 f. For the influence of Berossos (fl. *c.* 290 B.C.) see FHG, ii, 495–510; Bouché Leclercq, (1), 36; Cumont, (1), 163; Schnabel.

the Stoic Chairemon (1 cent. A.D.), the Cynic Oinomaos of Gadara (2 cent. A.D.), the Sceptic Sextus Empiricus (2 cent. A.D.), Alexander of Aphrodisias (*c.* A.D. 200), the gnostic Bardesanes (3 cent. A.D.), the Epicurean Diogenianos (3 cent. A.D.), the Neoplatonists Ammonios Sakkas (3 cent. A.D.) and Plotinos (3 cent. A.D.), and the Peripatetic John Philoponos (6 cent. A.D.).[1]

Chaldaean astrology is said to have been introduced to Rome by Poseidonios, but 'Chaldaeans' were in Rome at the time of Cato (234–149 B.C.) and were expelled by Publius Cornelius Scipio in 139 B.C.[2] In Cicero's time astrologers were well known; under Augustus (63 B.C.–A.D. 14) they were popular and the emperors had private astrologers (Tacitus[3] says one of Neros was called Pammenes, probably an Egyptian), and astrology flourished in the 3 cent. A.D., especially under Septimius Severus (A.D. 193–211). Astrologers were repeatedly banned from Rome, but always returned.[4] Diocletian's edict (A.D. 296) against astrologers in Alexandria was ineffective.[5] Constantine the Great (A.D. 274–337) believed in astrology.[6] The Fathers of the Church were mainly opposed to it, but did not question its reality.[7]

The supposed relations of the planets to colours and materials, especially metals, are of special interest. Herodotos[8] described the seven circular walls of Ekbatana (built in 607 B.C.), the two minor ones of gold and silver; and[9] the seven-stage tower (*Ziqqurat*) of Babylon. Both these were probably seen by Alexander the Great. The stages of the tower were coloured and probably represented the seven planets. Of the seven gates of Thebes, built by the Phoenician Kadmos, five were named after the planets.[10] Plato (see p. 66) described the metal walls of the mythical city Atlantis. Moses of Khoren (5 cent.) speaks of the 7 walls of Ganzakh as being like those of Ekbatana, and Niẓāmī (A.D. 1140–1202) in his *Haft paikar* of the 7 walls of the palace of the 7 planets built by Vāhrām V (Bahrām Gūr), who ascended the Persian throne in A.D. 420.[11] Al-Thā'lībī (A.D. 1010)[12] gives an old Persian legend that the (mythical) Shah Kaikāus built the Tower of Babel in 7 stages, of stone, iron, brass, copper, lead, silver, and gold. Firishtah[13] says Humāyūm (A.D. 1530–55), the son of Bābur, had 7 halls of audience named after the planets, using one of them each day in the week according to the planet of the day.

Before Alexander's time (356–323 B.C.) the Greeks had no special names for the planets, except Venus (Ἑωσφόρος or Ἕσπερος), but spoke of the 'star of Zeus' (ὁ ἀστὴρ τοῦ Διός), etc.;[14] the names of all the planets (as gods) are first

[1] Philoponos, *In Cap. I Genesios, De Mundi Creatione*, 4°, Vienna, 1630, 176 f.; Burckhardt, (1), 209–15, 227; Hopfner, (1), 267.

[2] Cumont, (1), 163; Gressmann, (2), 22.

[3] *Ann.*, xvi, 14.

[4] Bouché Leclercq, 543 f.; Burckhardt, Constantin, 1880, 212; Cumont, (1), 167, 180; Diel, (1), 45, 64, 93; Domezewski, *A. Rel.*, xi, 223; xiv, 313; Dombart, PW, II Reihe, ii, 1578 f.; Fluss, *ib.*, 1999; Friedländer, i, 133, 367 f.; iv, 176; Riess, PW, ii, 1802 f.

[5] Riess, PW, ii, 1825.

[6] Burckhardt, (1), 436.

[7] Thorndike, (1), i, 464 f., 514 f.

[8] i, 98.

[9] i, 181.

[10] Bouché Leclercq, (1), 41 f.; Brandis, *Hermes*, 1867, ii, 259 (266); Chwolsohn, ii, 659; T. Dombart, *Der Sacralturm*, Munich, 1920; *id.*, *Alte Orient*, 1930, xxix, no. 2; Hopfner, PW, xiv, 326; Jeremias, (1), 41 f.; *id.*, Ro., iii, 52; *id.*, *Das Alte Testament im Lichte des Alten Orient*, Leipzig, 1906, 14; Partington, (1), 273 f.; G. Rawlinson, *The Five Great Monarchies*, 1879, ii, 546; Stegemann, 234 f.

[11] Lenormant, (3), 227.

[12] (1), 165.

[13] Tr. Briggs, 1829, ii, 71.

[14] Plato, *Epinomis*, 986*e*–987*c*.

Table I

	SATURN	JUPITER	MARS	SUN	VENUS	MERCURY	MOON
1	white	brilliant	red	blazing	shining	sparkling	mild
2	livid grey	white	red	golden	yellow	variegated	silvery
3	μέλανα black	λαμπρὸν white	κιρρὸν red	διαυγῆ shining	ποικίλον variegated	ὦχρον yellow	ἀερωδη greenish
4	black	bluish	red	purple-red	blue	purple	green
5	black	—	red	golden	—	—	white
6	black	bluish	red	golden	blue	green	white
7	black	green	red	golden	blue	variegated	silvery
8	lead-grey	silvery	golden	—	whitish	black	tin white
9	black	white	red	white or golden	—	red or yellow	black and white
10	black	sandarach (yellowish-red)	red	golden	white	blue	green
11	black	green	red	golden	blue	variegated	white
12	black blue	ash-grey fiery	red	golden	red	blue	green
13	dark leaden	silvery	fiery red	golden	glittering white	bronze-red	white
14	dark	blue	white or red	garnet colour	green	variegated	white or green
15	ashy or black	green	red	fulgid	blue or purple	flame-coloured	silvery-white
16	pale (luridum)	white	fiery	—	yellow	variegated	—
17	deep black	dark beryl	poor red	dull yellow	white or green	emerald green	white or moderate blue
18	yellow	green	red	—	white or yellow	blue or black	—
19	blue	yellowish	red	red	white	green	white
20	black blue	yellow white	red	golden	white	blue	green white

(1) Pliny, ii, 16 (18), from Poseidonios?;
(2) Ptolemaios (*c.* A.D. 150), from Babylonian sources, Bouché Leclercq, (1), 313 f.;
(3) Vettius Valens (2 cent.) and contemporaries, Salmasius, (4), 620 f.; αερωδη is sky-coloured, but Porphyry gives πρασινην, green (*ib.*, 622), which is more likely (J. H. Krause, 66);
(4) Porphyry (3 cent.), Salmasius, (4), 621–2;
(5) Firmicus Maternus, *c.* A.D. 335, ed. Kroll and Skutsch, 1897, i, 6, 16, 35, 90, 152;
(6) ψ-Kallisthenes (4–5 cent.), *History of Alexander*, ed. Dübner, Paris (Didot), 1846, bk. i, ch. 4, p. 5; Berthelot, (4), i, 312; from the colours of the gems: ophites, aerites, haematite, crystal, sapphire, emerald, diamond; Budge, (8), 12;
(7) Arabic Encyclopaedia of the Brethren of Purity (10 cent.), from Greek sources, F. Dieterici, (1), 1876, v, 115. The same list is given by Al-Qazwīnī (d. A.D. 1283), Ruska, (1), 5;
(8) Daniel of Morley, *c.* A.D. 1200 (he says the stars are not really so coloured), C. H. Haskins, *Isis*, 1922, iv, 250 (260 f.); Sudhoff, *A. Nat.*, 1917, viii, 1 (30); Thorndike, (1), ii, 173, 178;
(9) Arabic MS. BN 2772 (de Slane's *Cat.*), written A.D. 1329, Ruska, *Isis*, 1913, i, 346–7; *id.*, (6), 20, 32, 40; *id.*, (7), 50;
(10) Nizāmī (*c.* A.D. 1150), Jeremias, (1), 86;
(11) Al-Dimashqi (A.D. 1256–1326), (1), 71 (Sabian account); Jeremias, (1), 86;
(12) Sābian accounts in Creuzer, (1), i, 127;
(13) Konstantinos Manasses (A.D. 1150), *Συνοψις ιστορικη*, in Meursius, *Opera*, 1746, vii, 353–4; ed. Bekker, Bonn, 1837, 8–9; A. B. Cook, i, 625;
(14) Cornelius Agrippa (1486–1535), *De Occulta Philosophia*, Cologne, 1533, bk. i, chs. 22–35;
(15) Egyptian, Arabic, and Hebrew sources in Kircher, (1), II, ii, 179 f.;
(16) Baptista Porta, *Coelestis Physiognomoniae*, Naples, 1603, 71; T. Taylor, *Proclus' Commentaries on the First Book of Euclid's Elements*, 1792, ii, 303;
(17) Late Syriac astrological treatise, Budge, (9), ii, 574;
(18) Chinese Taoist, J. F. Davis, ii, 277; Forke, (1), 275;
(19) Indian (from colours of gems), Finot, (1), 133, 175;
(20) Persian *Dabistān*, i, 35–42, 17 cent., q. *Akhtaristān* of unknown author and date.

given together by Aristotle.[1] Non-religious names, based on appearances, began to appear after Alexander, the oldest certain reference being in 261 B.C.[2] The colours attributed to the planets, probably of Chaldaean origin,[3] are mentioned by Pliny,[4] Artemidoros[5] and Firmicus Maternus,[6] who says the sun, moon, and stars 'paint' everything they influence, each with its own colour. It appears in later Oriental authors, such as Maimonides (1135–1204) and Shakrastani (d. 1153).[7] The colours are mostly fanciful.[8] In Table I they are collected from various sources.

The association of the planetary gods with parts of the body is found in old Babylonian texts,[9] although Origen[10] credits it to the Egyptians, and one list is said to be by Nechepso.[11] The idea occurs in Plato,[12] in Porphyry (quoting Demophilos),[13] in Iatromathematical works,[14] and in the *Hermippos*, a 14-cent. compilation by John Katrarios from a Greek translation of Albumasar.[15] The figure of a man (microcosm) in a circle marked with the signs of the zodiac, which appears as early as the 8 cent.,[16] is found in a great number of later works, especially Jewish,[17] and in Arabic works.[18] The relations of parts of the body to 'houses' of the planets (Saturn = spleen, Jupiter = liver, Mars = gall-bladder, Venus = stomach, Mercury = brain, Moon = lungs) appear in the Arabic encyclopaedia of the Brethren of Purity (10 cent.).[19] The planets were also related to (*a*) animals, (*b*) plants, (*c*) flowers ('stars of the earth'), (*d*) spices and incense, (*e*) gems, (*f*) other stones, (*g*) ages of man, (*h*) faculties, sensations, tastes, temperaments (saturnine, martial, jovial, mercurial, lunatic, sunny), (*i*) humours, (*k*) clothing, (*l*) vowels, (*m*) ages of the world, and (*n*) positions in the kosmos.[20]

[1] *Metaphys.*, *Λ*, 8, p. 1073b, from Eudoxos (408–355 B.C.).

[2] Bouché Leclercq, (1), 88 f., 101 f.; Cumont, *L'Antiquité Classique*, 1935, iv, 5–43; Festugière, (1), i, 93; W. Gundel, *Bursians Jahresbericht*, 1934, ccxliii, Abt. II, 1–162; A. E. Taylor, (1), 194 f. For representations of planets in MSS., see Hauber, *Planetenkinder und Sternbilder*, Strasbourg, 1916; Herzfeld, *Islam*, 1921, xi, 154; E. Littmann, *Islam*, 1918, viii, 134; F. Saxl, *Islam*, 1912, iii, 151–77; *id.*, *Sitzb. Heidelberg Akad.*, *Phil.-hist. Kl.*, 1925–6, no. 2; *id.*, *Isis*, 1928, xi, 497–8; Seeck, PW, iii, 2477; Stemplinger, 2.

[3] Jeremias, (1), 45, 47, 84 f.

[4] ii, 16.

[5] *Oneirokritika*, ii, 38 (ed. 1603).

[6] *Mathesis*, ed. Kroll and Skutsch, i, 6, 16, 35, 90, 152.

[7] Chwolsohn, ii, 439 f., 443, 455, 485.

[8] Bouché Leclercq, (1), 41, 313 f.; W. and H. Gundel, PW, xl, 2015; Jeremias, (1), 84; Roscher and Boll, Ro., iii, 2519.

[9] Bouché Leclercq, (1), 320; Hopfner, PW, xiv, 329; Lobeck, ii, 926 f.; Meissner, ii, 292.

[10] *Contra Cels.*, viii, 58; Maury, (2), 1860, 45.

[11] Boll, (3), 138.

[12] *Timaios*, 69 I, etc.; perhaps from Hesiod; Boll, (3), 138; Roscher and Boll, Ro., iii, 2534.

[13] Bouché Leclercq, (1), 322, 431, 534.

[14] Boll, (3), 54 f., 129 f., 134 f.; U. F. Kopp, 1829, iii, 348 f.

[15] Boll, (6); Bouché Leclercq, (1), 322; Thorndike, (1), i, 524.

[16] Boll, (3), 111, 136 (perhaps from Manilius).

[17] Jeremias, (1), 183; Kircher, (1), II, ii, 188 (q. Sextus Empiricus); Welling, *Opus Mago-Cabbalisticum*, Homburg vor der Hohe, 1735, 342.

[18] Al-Dimashqī, (1), 414; Kircher, (1), II, ii, 177 f., Boll (3), 54 f., 129 f., 134 f.; U. F. Kopp, 1829.

[19] Dieterici, (1), 1871, vii, 49, 61; Ptolemy's *Almagest* is quoted. A table of relations of planets to parts of the body and many other things was given by Cornelius Agrippa (1486–1535), *De Occulta Philosophia*, Cologne, 1533, pp. cxx–cxxi; Bouché Leclercq, (1), 609. The arrangement of Paracelsus (1493–1541) (*Opera*, Geneva, 1658, i, 235 f.) was: Sun = heart, Moon = brain, Jupiter = liver, Saturn = spleen, Mercury = lungs, Mars = gall-bladder, Venus = kidneys.

[20] (*a*) Cornelius Agrippa, *Occulta Philosophia*, bk. i, chs. 22–35; Budge, (8), 29; A. B. Cook, i, 625; Dieterich, (1), 52; (2), 71; Jeremias, (1), 85; J. Kroll, (1), 104, 107; Salmasius, (4), 623, 754; (*b*) Chwolsohn, i, 743 f.; E. H. F. Meyer, ii, 340 f.; W. Kroll, PW, viii, 792 f.; Wehrli, in

The most important planetary relation from our point of view is that with the metals. The association of certain planetary gods with metals and other materials is of early Babylonian or perhaps even Sumerian origin. Ellil, the god of Nippur, is called 'master of gold', and a bilingual (Sumerian-Akkadian) hymn says the fire-god Gibil with his pure and brilliant flame mixes copper and *anaku* (probably tin) and purifies gold and silver.[1] Ninib, son of Ellil, ruled over minerals, and there are several incidental associations of gods with metals and minerals.[2] In a text of the Kassite Period (1600–1400 B.C.), probably based on older sources, which contained a magic text from Nippur, 'not to be shown to the uninitiated', with sixty symbols and their divine implications, silver is associated with the Moon, gold with the Sun, lead with Ninmah, and copper with Ea.[3] The association of metals with planets is also revealed in

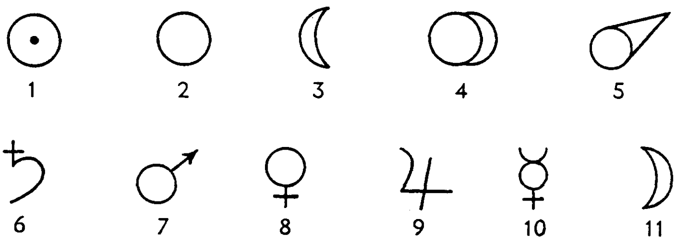


FIG. 7.

so-called Foundation Deposits, known from 2000 B.C. if not earlier, and found also in Egypt, Nubia and the Sudan. The best known of these is the one found at Khorsabad under a building of Sargon II (710 B.C.), the contents of which were analysed.[4] It contained bars of gold, silver, bronze (10·04% tin), and magnesite, with names given in inscriptions.

The relations of planetary gods with specific materials, referred by Hellenistic authors to the Egyptian Thoth-Hermes, is probably of Babylonian origin.[5] The symbol (1), Fig. 7 in ancient Egypt was associated with the name of the sun god Rē.[6] The Babylonian solar symbol (2), later with four or eight spokes, was introduced by the Hittites in the second millennium B.C.

Sudhoff, (1), 385 f.; (*c*) A. B. Cook, ii, 625, 772; Hopfner, PW, xiv, 311, 319, 321; Konstantinos Manasses, *Synopsis*, ed. Bekker, Bonn, 1837, 8–9; Lobeck, 841, 911; Salmasius, (4), 623; (*d*) A. B. Cook, ii, 625; Hopfner, PW, xiv, 326; Konstantinos Manasses, 8–9; (*e*) Bidez, (1), 1930, 77; Boll, (1), 413, 482; Budge, (4), 416 f., 423, 486; Kroll, PW, II Reihe, iv, 563; Meissner, ii, 132; Roscher and Boll, Ro., iii, 2519 f.; Ruska, (6), 20 f., 40 f.; P. Schnabel, *Berossos*, 1923, 130–2; a Babylonian astronomer Sudines (fl. 240 B.C.) is quoted on gems by Pliny; (*f*) Ruska, *op. cit.*; (*g*) Roscher and Boll, Ro., iii, 2519; (*h*) Boll, (3), 54, 129 f., 134 f.; *Dabistān*, i, 35–42 (tastes); Roscher and Boll, Ro., iii, 2534; (*i*) Boll, (3), *loc. cit.*; (*k*) *Dabistān*, i, 35–42; Hippolytos, *Refut.*, v, 7; (1), 142; Plutarch, *Isis and Osiris*, 77; Reitzenstein, (2), 72; *id.*, (5), 168; Salmasius, (4), 621; (*l*) Dieterich, (2), 32 f., 40; Hopfner, PW, xiv, 343; (*m*) Jeremias, (1), 203 f.; Lobeck, ii, 791; Roscher and Boll, Ro., iii, 2519; (*n*) Lobeck, ii, 896.

[1] Lenormant, (3), 185; Meissner, i, 229; ii, 15, 165, 207.

[2] Partington, (1), 278.

[3] Langdon, Sumerian Liturgies and Psalms, *University of Pennsylvania Museum Publications of Babylonian Section*, Philadelphia, 1919, x, no. 4, 334–9.

[4] Berthelot, (3), 80, 219; Partington, (1), 278–9.

[5] Berthelot, (3), 73–85; *id.*, (4), II, xv; *id.*, *Science et Philosophie*, 1905, 155; Boll, (3), 119, 130, 211; Bouché Leclercq, (1), 316; Bousset, *A. Rel.*, iv 1901, 229 (242); Hoefer, (2), i, 250; Hopfner, PW, xiii, 749; xiv, 326; Humboldt, (4), iii, 467 f.; Jeremias, (1), 86 f.; U. F. Kopp, 1829, iii, 334, 341; Meissner, ii, 132; Partington, (1), 177 f.; *id.*, *Ambix*, 1937, i, 61.

[6] Erman, (2), 115.

The moon was represented by a crescent either alone (3) or on the side of a circular disc (4); Venus by an eight- or six-rayed star or a disc containing this.[1] In magic papyri (e.g. the Papyrus Mimaut, 3 cent. A.D.) and in alchemical MSS. the sign (5) occurs for the sun or gold; it may represent the sun with the conical cap of Mithra.[2]

The origin of the planetary symbols, which were adopted by the alchemists for the metals, has been discussed since the 16 cent. The old 'mythological' interpretation saw in these the scythe of Saturn (6) for lead, the spear and shield of Mars (7) for iron, the looking-glass of Venus (8) for copper, the thunderbolt of Zeus (9) for tin.[3] Kircher[4] tried to find all other planetary symbols in the caduceus symbol for mercury (10), since alchemy originated with Hermes (Mercury) and quicksilver is the principle of all metals. The cross also denoted the four primary colours, black, white, red and yellow. Salmasius,[5] who traced in old Greek manuscripts in Paris the symbols of the five planets ((1)–(3), being symbols of ancient origin) as contractions of the Greek names, sometimes unusual, of the planets. Thus, from *Κρ*, the first two letters of the Greek name *Κρόνος* for Saturn, the symbol (6) is easily derived; the symbol (7) of Mars from *θούρας*; that of Venus (8) from the Greek-Egyptian name *Φωσφόρος*, and that of Mercury (10) from the Babylonian-Greek *Φωσφόρος*, that of Jupiter (9) from *Ζεύς*, and that of Mercury (10) from the Babylonian-Greek *Cτίλβων* (*C*=*Σ*). W. and H. Gundel[6] think the first mode of derivation is more likely, and the symbols (7) and (10) are probably from the attributes. The alchemists gave a different interpretation: silver (3) is inferior gold (2); in (10) there is gold with a silver colour and the cross is something without which mercury would be silver or gold, and copper (8) would be gold. In (7) philosophical gold is concealed, in tin (9) half is silver (half moon) with an unknown something (cross), in lead (6) this unknown is predominant, and in its symbol the cross is at the top and the silver symbol suspended below it.[7] In older lists the symbol for the metal mercury was the lunar crescent (1), turned the opposite way from that used for silver (3); in later lists it is given the symbol (10) of the planet Mercury,

[1] Jeremias, (1), 78, 105; *id.*, Ro., iv, 1434; Kugler, *Im Bannkreis Babels*, Münster, 1910, 61, 132 f., 151 f.; Prinz, *Altorientalische Symbolik*, 1915, 84; Scheftelowitz, *A. Rel.*, xv, 462, 473.

[2] Berthelot, (1), 332 f.; Dieterich, (1), 5, 64, 171 f., 186–90, 199 f.; Reitzenstein, (2), 147; it occurs in Firmicus Maternus, ed. Kroll and Skutsch, i, 42; for Syriac symbols, see *Causa Causarum*, ed. Kayser, Stuttgart, 1893, 284; Berthelot, (4), ii, 1,221; summary in Lippmann, (2), i, 347 f.

[3] *Manilii Astronomicon Interpretatione et notis ac figuris illustravit Michael Fayvs ... accesserunt V. Ill. Petri Danielis Hvetii* [Huet] *animadversiones ad Manilium & Scaligeri Notas*, Paris, 1679, 99; Goguet, ii, 370; M. Maier, *Viatorium, hoc est de Montibvs Planetarum septem, seu Metallorvm*, Rouen, 1651, t.p.

[4] (1), II, ii, 393 f., 399 f., 404 f., 407 f., 416, 434.

[5] (1), 1689, ii, 872; Beckmann, (1), ii, 23; Lippmann, (2), i, 347 f., 350 f.

[6] PW, xx, 2017–85 (2035): Planeten.

[7] Boerhaave, (1), i, 67 f. and Shaw's note, referring to Ducange, (1); Gessmann; the symbol (8) is the old Egyptian *crux ansata*, it is found (with a star inside the circle) on coins of King Euelthon of Cyprus (560–25 B.C.), and was well known in the Near East at the beginning of the Christian era: Gardthausen, PW, xvi, 141; White, *Sci. Progr.*, 1929, xxii, 687 (derived from Arabic numerals); T. Thomson, (2), 1802, i, 159; M. Wall, Conjectural remarks on the symbols or characters employed by astronomers to represent the several planets, and by chemists to express the several metals, *Manchester Mem.*, 1789, i, 243 (read 1782).

formerly used for iron or tin.[1] Glauber[2] put the planetary symbols inside squares, and according as they touched at four (gold), three (silver, mercury), or two (copper, iron, lead, tin) points, the metals decreased in perfection; by taking account of the curves in the symbols he made mercury, iron, and copper have half, and lead and tin only a quarter, of 'perfection'. J. Volhard[3] thought the planetary order of the metals is that of 'nobility', that is, a kind of electrochemical series, but iron is out of place and the idea is doubtful. V. E. Johnson[4] thought the order gave the supposed distances of the planets from the earth. The order gold, silver, bronze, iron in Daniel (ii, 31 f.)[5] is the same as in Hesiod and in Plato (*Republic*), and continued until the time of Claudianus (*c.* A.D. 400).[6] In Empedokles[7] the planetary gods are in the order Mars, Jupiter, Saturn, Venus.

The classical passage which describes the relations of the metals with the planets is in a lost work of Celsus, long extracts from which are given by Origen.[8] The work was known to Porphyry (A.D. 232–*c.* 305).[9] Celsus may have been the one to whom Loukian dedicated his book on Alexander of Abonoteichos (see p. 277); although Origen calls him an Epicurean he was probably a Platonist. His book, *The True Discourse* (*Λόγος 'Αληθής*), probably written in Rome about A.D. 177–80, was a refutation of Christianity, which he thought was a Jewish religion; Origen's reply was probably written about 248.[10] Celsus says that, according to Plato:[11]

'there is for souls a way to the earth (down) and a way from the earth (up), and these ways go through (the spheres of) the planets. These things are hinted at in the accounts of the Persians and especially the mysteries of Mithras which are celebrated amongst them. For in the latter there is a representation of the two (opposite) motions in the heavens [Celsus here thinks these are of the fixed stars (*sic*) and the planets] and the passage of the soul through them. The representation is as follows. There is a ladder (or stair) with seven gates (κλῖμαξ ἑπτάπυλος) and above that an eighth gate. The first gate is of lead, the second of tin, the third of bronze (or copper), the fourth of iron, the fifth of mixed metal (κεραστοῦ νομίσματος), the sixth of silver, and the seventh of gold. The first gate they assign to Kronos (Saturn), indicating by lead the slowness [in its revolution] of this star; the second to Aphrodite (Venus), comparing

[1] Berthelot, (3), 79, 84, 94.
[2] *Treatise of the Signature of Salts, Metals, and Plants*, *Works*, tr. C. Packe, f°, 1689, i, 270.
[3] *Z. f. Naturwissenschaften*, 1897, lxx, 37 (53).
[4] *Chaldean Science*, 1890, 59; ref. to the order in the Bible, *Numbers*, xxxi, 22.
[5] E. Meyer, (2), ii, 189 f., thought this came from the Persian *Avesta*.
[6] Reitzenstein, (5), 183; *id.*, (8), 209; Seeliger, Ro., vi, 375, 385 f., 391, 406.
[7] Eisler, (3), 30.
[8] Origen, *Contra Celsum*, vi, 22; text ed. Koetschau, Origen, GCS, 1899, ii, 92 (for MSS., *id.*, TU, 1889, vi, no. 1); revised text, ed. P. Wendland, GCS, 1916, iii; German tr. J. L. Mosheim, *Origenes . . . Acht Bücher von der Wahrheit der Christlichen Religion wider den Weltweisen Celsus*, 4°, Hamburg, 1745 (923 pp.), 627; Koetschau, Des Origines acht Bücher gegen Celsus, ii, 123 (in *Bibliothek der Kirchenvater*, ed. Bardenhewer, etc., Munich, n.d.); tr. T. Keim, *Celsus' wahres Wort . . . vom Jahre 178 n. Chr.*, Zürich, 1873, 84; French tr., Elie Bouhéreau, *Traité d'Origène contre Celse*, 4°, Amsterdam, 1700, 241, 394, 438; in Migne, *Demonstrations Évangéliques* (18 vols., 1843–52), 1843, i, 13–474; English tr., A. Roberts and J. Donaldson, ——, ANL, 1872, xxiii, 360; *Origen, Contra Celsum*, tr. with introd. and notes by H. Chadwick, Cambridge, 1953, 334.
[9] Wendland, 175.
[10] Bouché Leclercq, (1), 316; Bousset, *A. Rel.*, 1901, iv, 229 (237); Creuzer, (1), i, 757; Deussen, (1), II, ii, 307 (A.D. 178); Friedländer, I, xxv, xxvii; Keim, 84, 274 f.; Legge, (1), ii, 265; Lobeck, ii, 936; Mozley, DCB, i, 435; Neumann, PW, iii, 1884 f.; Wüst, PW, xv, 2131; Zeller, (1), III, ii[4], 231–2.
[11] *Phaidros*, xxviii, 248C–E; *Timaios*, 41B–E.

her with the brightness and softness of tin; the third to Zeus (Jupiter), the gate "with bronze hinges" and strong (τὴν χαλκοβάτην καὶ στερράν); the fourth to Hermes (Mercury), since both Hermes and iron are fit to endure all things and are money-making and laborious (τλήμονα γὰρ ἔργων ἀπάντων, καὶ χρηματιστήν, καὶ πολύκμητον εἶναι, τόν δε σίδηρον καὶ τὸν Ἑρμῆν); the fifth to Ares (Mars), because being composed of a mixture of metals it is varied and not uniform; the sixth, of silver, to Selene (Moon), and the seventh, of gold, to Helios (Sun), imitating these in colour. He (Celsus) next proceeds to examine the reason for the stars being arranged in this order, which is symbolised by the different kinds of matter (τῆς ποικίλης ὕλης;) musical reasons, moreover, are added or quoted by the Persian theology, and to these again he tries to add a second explanation, also connected with musical considerations.'

The order of the planetary spheres is that of the days of the planetary week, beginning with Saturday, corresponding with the planet Kronos (Saturn) as farthest from the earth.[1] The eighth gate would be that of the Ogdoas or region of fixed stars. The MS. reading ὑψίπυλος, 'lofty gates', was corrected by Bouhéreau[2] to ἑπτάπυλος, 'seven gates'; the technical term κλῖμαξ ἑπτάπυλος occurs only in Origen, but 'gates' or 'doors' have been mentioned in the *Chaldaean Oracles*.[3] The κεραστοῦ νομίσματος, which may mean 'mixture for coinage' or 'the usual mixture', was supposed by Seeliger[4] to be brass, but it is probably electrum, the old Lydian coinage metal; 'mixed metal' is implied later in the passage. The MS. reading χαλκοβάτην, 'bronze floor', was corrected by Koetschau to χαλκοβατῆ, since χαλκοβατὲς is in Homer[5] for the palace of Zeus, as Keim pointed out.

The ladder of Mithra may be related to the old Babylonian stage-tower,[6] perhaps to the Buddhist *stūpa*[7] and also to Jacob's ladder.[8] The Hebrews brought a knowledge of the stage-tower (Tower of Babel) from north-west Mesopotamia about or before 1500 B.C.[9] J. Kroll[10] and W. Scott[11] related the ladder to Stoic sources in Poseidonios (who has only two stages). W. R. Halliday[12] thought the ladder of Mithra is a Greek reduplication of a vision of Hades in the 5 cent. B.C., which later absorbed an astral eschatology and geography of Hadès transferred to the heavens, some ritual actions (climbing steps, etc.) representing the Platonic ascent of the soul. Apart from Egyptian and Babylonian ladders, and Jacob's ladder, it seems likely, however, that Celsus was correct in giving a Persian source.[13] A ladder with seven steps is shown on a Classical terra-cotta representing a collection of amulets.[14]

There are reminiscences of the association of the metals and planets in other authors.[15] Nonnos of Panopolis (*c.* A.D. 440–90)[16] has only the relations Sun = gold and Moon = silver,[17] but he says that Kadmos built Thebes with seven doors in imitation of the heavenly city (representing the planets),[18] the necklace of Harmonia was composed of seven gems,[19] and a wall was decorated with seven tablets of different metals (representing the planets).[20] The earliest reference to seven metals is by Pausanias (*c.* A.D. 150):[21] iron, copper, lead, tin,

[1] Gasquet, 58; cf. E. G. Browne, (1), 61.
[2] *Traité d'Origène contre Celse*, Amsterdam, 1700, 394.
[3] Bousset, *A. Rel.*, iv, 263.
[4] Ro., vi, 383.
[5] *Il.*, xxi, 438.
[6] Anz, 78 f., 87; Dieterich, (2), 1903, 89, 186, 189 (not to the Çinvat bridge in the *Avesta*); Eisler, (1), 299; Gasquet, 63.
[7] A. B. Cook, ii, 129.
[8] Dieterich, (2), 89, 186.
[9] Albright, 181.
[10] (1), 1914, 294.
[11] (1), ii, 60.
[12] 261–2, 295 f., 297; q. Cicero, *Tusc. Disp.*, I, xii, 29.
[13] Jeremias, (1), 4.
[14] Flather, DA, i, 120.
[15] Lobeck, 936.
[16] Friedländer, *Hermes*, 1912, xlvii, 43.
[17] *Dionysiaka*, xxv, 390 f.
[18] *Ib.*, v, 52 f.; Stegemann, 230 f.
[19] *Dionys.*, v, 135 f.
[20] Reitzenstein, (5), 184.
[21] viii, 18; Zielinski, *A. Rel.*, ix, 49.

Table II

	SATURN	JUPITER	MARS	SUN	VENUS	MERCURY	MOON
1	a metal?	—	—	gold	lead	—	silver
2	—	—	—	gold	copper	—	silver
3	lead	bronze	mixed metal	gold	tin	iron	silver
4	lead	tin	iron	gold	copper	electrum [mercury]	silver
5	lead	electrum	iron	gold	copper	tin	silver
6	—	—	—	gold	—	—	silver
7	lead	electrum or mixed metal	iron	gold	copper	tin	silver
8	iron	electrum	bronze	gold	tin	lead	silver
9	lead	iron	mixed metal	gold	bronze	tin	silver
10	lead	tin	iron	gold	{copper or bronze	mercury	silver
11	lead	—	—	gold	bronze	tin	silver
12	lead	bronze	iron	gold	tin	copper	silver
13	lead	tin	iron	gold	copper	mercury	silver
14	lead	tin	iron	gold	copper	mercury	silver
15	lead	brass	iron	—	—	electrum	silver
16	lead	tin	iron	gold	copper	{electrum mercury	silver
17	lead	tin	iron	gold	copper	?	silver
18	lead	tin	iron	gold	copper	mercury	silver
19	lead	silver	iron	gold	tin	bronze	crystal
20	copper	gold	iron	electrum	tin	lead	silver
21	lead	tin	iron	gold	copper	mercury	silver
22	lead	tin	iron	gold	{copper or brass	electrum	silver
23	—	bronze	copper	—	—	mercury	—

(1) Babylonian list of the Kassite period (1600–1400 B.C.); Langdon, the planetary gods have been equated according to the usual scheme. Ea, who is associated with the constellation Draco, not a planet (G. Rawlinson, *The Five Great Monarchies*, 1875, i, 122), is associated with copper; Partington, (1), 277 f.

(2) Babylonian list given by Virolleaud, q. by Jeremias, (1), 86.

(3) Celsus (*c.* A.D. 174–8), q. by Origen, *Contra Celsum*, vi, 22 Lippmann, (2), i, 218, thought 'mixed metal' was an alloy of 7 or more metals.

(4) Vettius Valens, 2 cent. A.D.; Roscher and Boll, Ro., iii, 2534.

(5) Alexandrian scholiast on Pindar (*Isthmian Odes*, v, 2; Pindar, *Opera*, ed. A. Boeckh, Leipzig, 1819, ii, 540; Berthelot, (3), 77; Fabricius, (1) (*a*), 1714, vi, 809; Jeremias, (1), 88; Lobeck, ii, 936.

(6) Eustathios, commentary on Homer's Iliad; Fabricius, (1) (*a*), vi, 809; Lobeck, ii, 936; Sun=gold, Moon=silver, 'and the other planets are put for the other metals'; Beckmann, (1), ii, 26; Berthelot, (3), 77.

(7) Proklos, commentary on Plato's *Timaios*, 18B, ed. Diehl, Leipzig (Teubner), 1903, i. 43 (giving only gold, silver, lead, and iron); T. Taylor, *The Commentaries of Proclus on the Timaeus of Plato*, 4°, 1820, *id.*, *Two Treatises of Proclus*, 1833, 108 (giving the alternative for Jupiter); Lobeck, ii, 936. The full list is given by Olympiodoros (6 cent.) in his commentary on Aristotle's *Meteorology* (iii, 6); Ideler, (2), ii, 163 (and note on ηλεκτρον); *Comment. in Aristot. Graec.*, ed. Stüve, Berlin, xii, 266. The same list is in the St. Mark's alchemical MS. (10 cent.,) but the lists in Paris alchemical MSS. vary: Amheilon, NEM, An VII, v, 369; Berthelot, (3), 73 f., 81 f., 92 f., 104 f.; Ducange, (1), ii, Appendix, 6 f., 16 (astronomical), 19 f. (alchemical, incl. planetary); Fabricius, (1) (*a*), 1724, xii, 768; Hoefer, (2), i, 253; Montfaucon, (1), 375; Zuretti, CMAG, viii, 1 f., 15 f., etc.

(8) The Venerable Bede (A.D. 673–735), *De Planetis*, in *Opera*, f°, Cologne, 1612, i, 372 (ordo Planetarum iuxta naturam et numerum earum secundum Hebraeos).

(9)–(11) Lists q. by U. F. Kopp, iii, 347 f., from Ducange, (1), ii, Appendix, 16 f.; Bousset, *A. Rel.*, iv, 242; (10) is found in the Jewish *Qabbalah*; Budge, (4), 394 f. (also Jupiter=silver).

(12)–(13) From various sources, some Arabic, in Kircher, (1), II, ii, 36, 179 f.

(14) Stephanos of Alexandria (7 cent.), MS. BN grec 2327 f. 73 *v*; Bäcker, MGM, 1925, xxiv, 58; Beckmann, (1), ii, 26; Berthelot, (3), 84, 294; J. M. Gesner, De electro alterum, in *Comment. Soc. Sci. Gott.*, 1753, iii, 67 (74); Lagercrantz, CMAG, ii, 349 f.; Lobeck, ii, 936.

(15) Arabic list, Ruska, *Isis*, 1913, i, 346–7; *id.*, (6), 20.

(16) Syriac *Causa Causarum* (11–12 cents.), K. Kayser, (1) 248, 284, 348 (Mercury associated both with electrum and mercury); the planets are in the Ṣābian order, Bousset, *A. Rel.*, iv, 242; same list in the Syriac *Book*

of Medicines, Budge, (9), ii, 574; the Syriac *Dictionary* of Bar Bahlūl (*c*. A.D. 950) gives Moon = silver, Venus = 'white copper', Jupiter = tin; Chwolsohn, ii, 659 f.; Duval, in Berthelot, (4), ii, 122 f.

(17) Sābian account in Al-Dimashqī (*c*. A.D. 900), (1), 53 f., 71, 227; Chwolsohn, ii, 839 (zinc under Mercury; Arabic *khār sīnī*; Hommel, *Z. angew. Chem*., 1912, xxv, 100, thinks it was (antimony or antimonial lead); Wiedemann, *Sitzb. Erl*., 1911, xliv, 81.

(18) Arabic list in Jeremias, (1), 88; Stitt, Notes on some Maldivian Talismans, JRAS, 1906, 121 f., 124 (the metals have numerical values: gold 1 and 4, silver 2 and 7, iron 9, mercury 5, tin 3, copper 6, lead 8).

(19) Konstantinos Manasses (A.D. 1150), *Synopsis Historike*, ll. 113–34; ed. Bekker, Bonn, 1837, 8–9; in Meursius, *Opera*, Florence, 1746, vii, 353–4; Beckmann, (1), ii, 26; A. B. Cook, i, 625 (adds Mars = iron from another Byzantine list); Fabricius, (1) (*a*), vi, 809; another list in *Maximi et Ammonis Carminum de actionum auspicius reliquiae. Accedunt Anecdota Astrologica* (from Laurentian MS 38), ed. A. Ludwich, Leipzig (Teubner), 1877, 121.

(20) BN MS. grec 2556, J. A. Cramer, *Anecdota Graeca e Codd. Manuscriptis Bibl. Reg. Parisiensis*, Oxford, 1841, iii, 113. 4 f.; A. B. Cook, i, 626; O. Gruppe, *Griechische Mythologie*, 1906, ii, 1491.

(21) *C. Agrippa, De Occulta Philosophia*, bk. i, cc. 22–35 (also gold and silver, Jupiter; copper, Mars; tin, Mercury); in a German-Swiss Iatromathematical MS. (*c*. A.D. 1400) iron is 'Stachel' (*i.e.* steel); Sigerist, *A. Med*., 1925, xvii, 229.

(22) Late Syriac astrological work, Budge, (9), ii, 574.

(23) Thaddeus Hagecius ab Hayek, *Commentarium in Hermetis Trismegisti Aphorismos . . . De Metoposcopia* (16 cent.), q. by Lobeck, ii, 936 ('Fragm. Astrol. in Thadaei Hagecii Opusc. Ann. 1563. cap. V'; Thorndike, (1), vi, 72, gives *Aphorismorum Metoposcopicorum*, 1584 (BM 1141. b. 11. (2.); on Hagecius as an alchemist, *ib*., v, 416).

gold, silver, elektron (electrum, still regarded as a single metal). Table II[1] summarises a number of correlations of planets and metals in various sources.

A detailed list[2] includes not only metals but also other substances: Saturn, representing lead, litharge, λιθ. μυλῖται,, jet (γαγάτης), μεταλλικῶν κλαυδιανος (an alloy); Jupiter: tin, beryl, λιθ. λευκός, sandarach, sulphur; Mars: iron magnet, ψηφῖδες λίθυκος πυρροὶ; Venus: copper, pearl, onyx, amethyst, naphtha, pitch (πίσσα), asphalt, honey, sugar (σάχαρι), ammoniac resin (ἀμμωνια κὸν θυμίαμα); Hermes: emerald, jasper, chrysolite (ἡσύχιον), mercury (ὑδραργυρος), electrum, libanos, mastic; Moon: silver, glass (ὑελος), antimony (στιμμι), white earth, ξινη, χια, χανδρα.

The identifications Sun = gold, Moon = silver in all the lists except numbers 19 and 20 are undoubtedly very old[3] and are probably based on colours. Jeremias[4] thought the identification Venus = copper is also Babylonian, since the 'cosmic' triad Anu = silver, Inlil = gold, Ea = copper (see no. 1) represented the 'revolution' triad Sin = Moon, Shamash = gold, and Ištar = Venus = copper; also he thought that the relation was connected with the relative times of rotation of the planets, those of the Sun and Moon being $360 : 27 = 13\frac{1}{3} : 1$, about the same as the old relative values of gold and silver. Copper and silver had the relative values 1 : 60 or 1 : 72, which Jeremias thought were related to the division of the year into 60 weeks of 6 days or 72 weeks of 5 days. In the lists, the identification Venus = copper is not so uniform as in the case of gold and silver. Mars = iron is predominant (for an obvious reason, iron being the metal of weapons). Clement of Alexandria[5] says that 'the Greeks called iron Ares (Mars) and wine Dionysos according to a certain relation'. All the lists except numbers 8 and 20 give Saturn = lead, which suggests that it is old. The identification Mars = 'mixed metal' in number 3 may be old, since the Babylonians regarded that planet as 'variegated'.[6] J. G. Eichhorn[7] and Bousset[8] thought the whole list is Babylonian, since the colours of the walls of Ekbatana[9] may refer to metals; this is doubtful. The discrepancies in the lists were

[1] Partington, *Ambix*, 1937, i, 61.
[2] Ludwich, *Anecdota Astrologica*, 1877, 121 (see (19) in note); J. E. Mercer, 218.
[3] Bouché Leclercq, 315; Lobeck, 934 f.
[4] (1), 86 f.
[5] *Strom*., viii, 9; ANL, xii, 444.
[6] Jeremias, (1), 88.
[7] In Beckmann, (1), ii, 26.
[8] *A. Rel*., 1901, iv, 229 (237).
[9] Herodotos, i, 98.

pointed out by Borrichius,[1] who 'corrected' Celsus' list (3) to the commonly accepted one (10). Most interesting is the replacement of various metals by the metal mercury in the case of the planet Mercury, which occurs in (14) (7 cent.), but may be older.[1]

Although the association of metals and planets goes back to old Babylonian texts,[3] the planetary symbols for the metals in the Greek chemical texts may have come from a Persian source (the oldest mention, in Celsus, refers to the mysteries of Mithra, see p. 305). In the MSS.[4] the 'Persians' are mentioned twice in relation to the list. The Syriac list[5] gives the planetary gods the Babylonian names (Bêl, Bilati or Ishtar, and Nebo). The Paris MS grec 2419 (containing some Hebrew letters) may go back to a Chaldaean source.

In old Persian accounts, Zoroaster sees in a dream a tree with four branches, of gold, silver, steel, and mixed iron; in Middle Persian works it has seven branches, of the planetary metals. The four metals correspond with the four ages of the world, as in Hesiod (different metals), and perhaps to the idol of gold, silver, copper, and iron (with feet of clay) in Daniel (ii, 32–3). In the Indian *Mahābhārata* there are four (white, yellow, red, and black) colours, also seven (planetary) colours, perhaps under Babylonian influence, and metals are arranged in order of value.[6] In the old Babylonian Gilgamesh epic, trees are partly of lapis lazuli and bear precious stones as fruits; in Hindu, Chinese, and Japanese legends of Paradise, there are gold and silver trees with blossoms of gems.[7]

The steps of the ladder of Mithra were probably not of the actual metals (gold and silver would be too expensive) but painted to represent them in the planetary colours. They may have had the planetary symbols on them; in the remains of a Mithraeum there are seven 'gates' bearing pictures of the planets.[8] The association of the metals with the planets implied that each planetary god created his particular metal in the earth and gave it his special characteristics. Proklos (5 cent. A.D.) explained that rays from the planets produce metals of various colours in the bowels of the earth, a theory later adopted by the Arabs.[9] Lead, associated with Saturn, is pale and cold, and usually moist.[10] In Ptolemaios, Saturn, distant both from the Sun and the Earth, is cold and dry,[11] whilst in Plato,[12] quoting Herakleitos, and also the Stoics, Saturn is moist, the 'master of humours' (ῥεύματα).[13] Martianus Capella (*c.* A.D. 430) gives Saturn the emblem of a lead vase from which pours a stream of cold water.[14] Lead, harmful and used in magic, was the metal of the evil Seth-Typhon and his star Kronos-Saturn; later of Hekate; lead was

[1] (1), 1668, 29.
[2] Bouché Leclercq, (1), 316 f., thought in the 4 cent., when electrum disappeared from the list; Partington, *Nature*, 1931, cxxviii, 666.
[3] Partington, (1), 277 f.; R. C. Thompson, (1), xxxix.
[4] Berthelot, (2), ii, 24, n. 4; 25, n. 2; iii, 25–6.
[5] Berthelot, (4), ii, 11–12. [6] Reitzenstein, (7), 45, 57.
[7] Lippmann, (3), ii, 11; D. Mackenzie, (2), 178.
[8] H. Chadwick, *Origen*, *Contra Celsum*, Cambridge, 1953, 334.
[9] Albertus Magnus, *De Mineralibus*, bk. iii, ch. 5; Beckmann, (1), ii, 27; Berthelot, (1), 49; *id.*, (3), 78; Chwolsohn, ii, 659; Dieterici, (1), v, 114 f.; Hopfner, PW, xiii, 749; xiv, 315, 326; Ruska, (3), 22.
[10] Eitrem, (1), 32f., 43; Hopfner, PW, xiv, 326 f.; Mayer, Ro., ii, 1473
[11] Uhlemann, 1857, 69 f.
[12] *Kratylos*, 401–2; *Works*, 1854, iii, 318: κρόνος κρουνὸς, a rivulet
[13] Mayer, Ro., ii, 1473 f.; Kronos = Saturn, 300 B.C., Seeliger, Ro., vi, 413.
[14] Bouche Leclercq, (1), 96.

black, heavy, dull-sounding and *poisonous*; Saturn had a double nature. The dull sound of lead was regarded as unfavourable; a demoness *'Ονοσκελίς* was born from the echo of it.[1] In a chronicle of *c.* A.D. 1200 the metal of 'wild Saturn' is 'koksilber' (quicksilver).[2]

Tin, a lucky metal from its association with Jupiter (Jove), was 'jovial',[3] although gold and silver were sometimes so described.[4] Abū Ma'shar (Albumasar) (9 cent.) says that the Persians first related tin to Hermes and electrum to Zeus; the Syriac dictionary of Bar Bahlūl (*c.* A.D. 950) gives the four relations: Sun = gold, Moon (Sahrō) = silver, Venus (Belatī) = copper, Jupiter (Bīl) = tin, 'according to the alchemists.'[5] Iron (always opposed to copper and bronze) was used in magic as an enemy of demons (iron and gold occur combined in rings); in gathering magic plants rings were drawn round them with a sword, but the plants must not be touched with iron.[6] As the metal of Mars it was 'fiery' and its red rust suggested the colour of blood; Didymos in a commentary on the *Iliad*, written shortly before the beginning of the Christian era, calls Mars 'the star of iron'.[7] The Egyptians gave the black stone basalt the name of iron;[8] iron was the metal of heaven but also of Seth.[9]

Metals were used as amulets partly because of their supposed relations with planets.[10] An amulet of 'seven' metals, with astrological signs, contained only three, tin, lead, and zinc, but the Persian *haftjus* (still used) contained equal proportions of gold, silver, copper, iron, lead, tin, and zinc; a corresponding Indian alloy, *aṣṭadhātū*, contained mercury in addition, and mercury alone, inside a nut or cylinder of metal, was worn in Syria and elsewhere as an amulet.[11] Malay tribes think gold, silver, and tin are inhabited by spirits, which grow and can be cultivated. The metals should be dug with special ceremonies, all unpleasant sounds being avoided, and can then be used for religious purposes and ceremonies.[12]

[1] Boll, (3), 126; Hopfner, PW, xiv, 326 f.; Seeliger, Ro., vi, 413; Stemplinger, 65.
[2] Grimm, *Deutsche Mythologie*, 1875, Nachtr. 83.
[3] Bouché Leclercq, (1), 284.
[4] Agrippa, *De Occulta Philosophia*, bk. i, ch. 26.
[5] Berthelot, (4), ii, 121 f., with symbols; Chwolsohn, ii, 659–60.
[6] Eitrem, (1), 43, 56; Hopfner, PW, xiv, 324, 326; Lobeck, 896.
[7] Berthelot, (3), 77.
[8] Berthelot, (3), 251.
[9] Partington, (1), 86 f.; in Homer's *Iliad* the sky is bronze, in the *Odyssey* it is usually iron; Semper, ii, 480 f., 490; Stoll, 378 f., 382 f., 413.
[10] Budge, (4), 489.
[11] Seligmann, (1), ii, 6 f., 18; *id.*, (2), 156 f., 174 f., Fig. 50.
[12] Skeat, 250–74; medicine, 408–57.

CHAPTER XVI

MITHRAISM

A cuneiform text of *c.* 1400 B.C. found at Boghazköy, the former Hittite capital in Asia Minor, shows that the Mitanni in Mesopotamia had as gods Mitra (Mithra), Indra, Varuṇa, and the Nāsatyas; the first two are found in India and Persia, the last two in India only. This makes it probable that the Hindus and Iranians had a common origin.[1] Mithra was originally an Iranian god of celestial light, not so important as the supreme sky god Ahura Mazda (see p. 323) but still significant. In the *Avesta* (see p. 323) he is never identified with the sun.[2] Mithraism developed into a mystery religion in its transmission to the west, when it acquired elements from Babylonia and Asia Minor; about 250 B.C. Mithra was identified with the Babylonian sun god Shamash, ruler of the planetary gods. The astrological elements, foreign to the old Iranian religion, were important later. Mithraism was never popular in Greece, perhaps because of the traditional enmity towards Persia, or at first in Egypt, although there was a mithraeum in the Fayyūm in the 3 cent. B.C.[3] In spite of Babylonian influence, Mithraism retained its Iranian character, and for the Greeks its mysteries were always 'Persian (*Περσικὰ μυστήρια*)'.[4]

In the late Hellenistic and Roman period Mithra was the father of the sun god Helios, or (since 'father and son are one') Mithras-Helios or Helios (Sol) himself, the invincible ('*Ἥλιος ἀνίκητος*, Sol invictus—of Syrian origin); he was identical with Apollo, and in the period of syncretism with Hermes, Jahwe, Iao, etc.[5] Mithraism incorporated old Greek ideas of stars possessing souls, Neopythagorean teaching that light is a symbol of god, and Stoic and Neoplatonic ideas; it also took over old rites such as cave-dwelling, the use of animal masks and cries, and dangerous initiations.[6] Its most important non-Iranian component was astrology;[7] in a Milan inscription a Mithraic priest is called 'studiosus astrologiae'.[8]

[1] C. Bezold, *A. Rel.*, 1912, xv, 206; E. König, *ib.*, 1914, xvii, 39; Christensen, (1); Gressmann, (1), 1930, 139; J. H. Moulton, (1), 115, 139; Partington, (1), 394.

[2] Hertel, (3).

[3] Anz, 78 f.; Bousset, *A. Rel.*, iv, 168; Cumont, (3), 2, 7 f., 10 f., 31, 101, 123, 146, 198; *id.*, (6); Eisler, (1), 176–9; Gressmann, (1), 146–52; Gruppe, Ro., iii, 2265; Jeremias, (1), 247; H. S. Jones, ERE, viii, 752–9; H. Leclercq, DACL, 1934, ix, 1498–1554; Nock, (4), (5); L. Patterson, *Mithraism and Christianity*, Cambridge, 1921 (pp. 102); Reitzenstein, *A. Rel.*, 1930, xviii, 42 (71); Richter, Ro., iv, 1137–52 (Sol); Wesendonk, (1), 119; Wüst, PW, xv, 2131–55.

[4] Cumont, (1), 146; (3), 21 f.; Dill, (1), 598 f.

[5] Albright, 276; *ψ*-Clement, *Homil.*, ed. Dressel, 18, 162; Cumont, (3), 18, 31, 86, 143, 196, *id.*, (6), 3048; Dieterich, (2), 68, 155; Fahz, *A. Rel.*, xv, 418; Nock, (4), (5).

[6] Anrich, 5; Bidez, (1), 222; Cumont, (3), 27, 36, 165, 194; *id.*, Ro., ii, 3036.

[7] Bouché Leclercq, 316; Dieterich, (2), 51; Dill, (1), 602.

[8] Gressmann, (2), 23.

Plutarch[1] says Mithraism became known in the west through Cilician pirates captured by Pompey in 67 B.C. In A.D. 50–100 it was popular among Roman soldiers and lower officials. It was, apparently, confined to men.[2] The oldest Mithraic temples in Rome were in the time of Trajan (A.D. 98–117) and Hadrian (117–38) but the cult first became important under Commodus (180–92), who participated himself. It was favoured by the emperors Septimius Severus (193–211), Heliogabalus (218–22) and Alexander Severus (222–35); Aurelianus (270–75) introduced *Sol invictus* into the state pantheon and ruled as an absolute monarch 'by the grace of God'.[3] The crown of rays, worn by the Ptolemies and Seleucids, was first adopted in Rome by Nero (54–68), then by Caracalla (211–17).[4] The last emperor to worship Mithra (for a brief period) was Julian (361–3).[5] In his time the cult was well established in Alexandria.[6]

Mithraism has no literary remains, and what is known of it comes from the remains of Mithraic temples and inscriptions, and notices in Classical and Patristic authors, who did not always understand it. The works on it by Eubulos and Pallas (Hadrian's time), mentioned by Porphyry, are lost.[7] The name *Μίτρα* (sometimes confused with the goddess) occurs in Herodotus, Xenophon[8] has *Μίθρας*, Strabo[9] *Μίθρη*. The oldest (A.D. 81–92) Latin reference (torquentem cornua Mithram) is in Statius.[10] The seven letters of the name in the form *Μείθρας* relate Mithra with the 7 planets and their numerical total 365 to the gnostic Abraxas (see p. 261).[11] Some gnostic gems have Mithraic figures on one side and Abraxas on the other.[12] Plutarch[13] calls Mithra *Μεσίτης*, since he mediated between Ormudz and Ahriman (see p. 224), but this is a late description.[14]

Porphyry[15] mentions the Mithraic cave (*σπήλαιον*), calls Mithra 'the demiurge and lord of creation', and identifies him with Kronos and Helios. Firmicus Maternus (A.D. 340–50)[16] mentions the cave, the representation of the elements, and a formula. Tertullian (*c.* A.D. 160–225)[17] mentions a rite of baptism, a mark made on the forehead, and a ceremony of putting a garland on the head, taking it off, and saying: 'Mithra is my garland.' There were sacrificial meals, and ordeals of initiation, apparently severe, at least for ordinary worshippers, although the ceremony is largely conjectural.[18] There were seven grades of initiates, corresponding with army ranks, and a relation

[1] *Pompey*, xxiv; *Vitae*, ed. Doebner, Paris (Didot), 1847, ii, 752; E. Meyer, (2), ii, 91; iii, 393.
[2] Cumont, (3), 27, 36, 165, 194; Duchesne, i, 393 f.; Halliday, 281 f., 287 f.; Harnack, (1), 535; Reitzenstein, (4), 1927, 95; Stemplinger, 2 f.
[3] Cumont, (3), 85, 90; (2), 105; Richter, Ro., iv, 1143.
[4] Cumont, (3), 85, 90, 100, 185.
[5] Bidez, (1); Gressmann, (1), 146–52.
[6] Cumont, (4), ii, 44.
[7] Legge, (1), ii, 236.
[8] *Cyrop.*, vii, 5.
[9] XV, iii, 13.
[10] *Thebaidos*, i, 720; Postgate, (1), ii, 313; J. Poppelreuter, *Islam*, 1918, viii, 295.
[11] Macarius, *Abraxas, seu Apistopistus*, Antwerp, 1657, 11; Reitzenstein, (2), 273.
[12] Stokes, DCB, iii, 926.
[13] *Isis and Osiris*, 46.
[14] Cumont, (3), 129; Wesendonk, (1), 58, 66.
[15] *De antro nymph.*, 5, 6; Halliday, 293, 319.
[16] *De errore profan. relig.*, v, 1 f.; ed. Heuten, 1938, 50 f., 148 f.
[17] *De Baptismo*, 5 (Migne PL, 1844, i, 1204); *De Corona*, 15 (Migne, PL, 1844, ii, 102); *De praescr. haer.*, 40 (Migne, PL, 1844, ii, 54).
[18] Dieterich, (2), 166 f., 173 f.; Réville, 101 f.

with the seven planets is probable.[1] There may have been magic rites, performed by the priest,[2] but he was subordinate; the initiate saw for himself the symbols in the artificial cave (σπήλαιον)[3] and perhaps first descended the 7 steps of the 'ladder (κλῖμαξ)', mentioned only by Celsus (A.D. 178)[4] (see p. 258). He also saw the images of Mithra and the lion-headed Kronos which were brightly illuminated and covered with symbols which he did not yet understand; perhaps he uttered a cry of rejoicing like that used in the later form of the myth of Osiris: 'εὑρήκαμεν (He is found!).'[5] He then perhaps ascended the 7 steps of the ladder, which may have represented a Babylonian stage-tower, or be of Egyptian origin.[6] In a vision of Zosimos (*c.* 250 A.D.) the alchemist first descends 15 dark steps and then ascends 15 light ones.[7]

Mithra is represented between two youths carrying an upright and an inverted torch, forming a 'triple Mithra', and he himself is sometimes called triplex (τριπλάσιος).[8] He was described as dressed in white, with a scarlet cloak, and wearing a fiery crown.[9] In a late picture he wears a sky-blue mantle spangled with seven golden stars, the sun and moon being shown separately at the corners.[10] He usually wears the so-called Phrygian cap (μίτρα).[11] He is shown accompanied by Helios crowned with rays.[12]

In his last days Mithra was a universal god (or his first emanation or *logos*), the aggregate of the sacred elements, the creator, ruler, guardian, and protector of the world.[13] He, like Hermes, guided the soul through the planetary spheres, and received and judged it in heaven.[14] The classical scenes showing Mithra slaying a bull are all copies of one made in Pergamos.[15] The mystic animals shown had a sacred significance. From the corpse of the bull sprang plants and herbs, from the spinal marrow wheat, from the blood wine (replacing the Persian *haoma*). The sperm, purified by the moon,[16] produced animals, the soul rose to heaven. At the end of the world Mithra will appear on a bull and Ahriman and all his devils will eventually be destroyed in a universal conflagration.[17]

There was also a legend of 'Mithra born from a rock (*de petra natus*)', or the 'god from a stone (θεὸς ἐκ πετρας; τὸν πετρογενῆ Μίθραν)', perhaps from the worship of a sacred stone (βαίτυλος, a meteorite) in Asia Minor, which passed

[1] Anrich, 45; Cumont, (3), 39, 155, 167; *id.*, Ro., ii, 2063; Dieterich, (2), 40 f., 69; Halliday, 300.
[2] Bidez, (1), 76 f.; Legge, (1), ii, 276.
[3] In the *Avesta*, caves are 'ears of the earth'; Hertel, (3), 196.
[4] Origen, *Contra Celsum*, vi, 22; Nock, (5).
[5] Augustine, *Civ. Dei*, vi, 10.
[6] Anz, 84; Lenormant, (3), 227; Reitzenstein, (5), 170.
[7] Berthelot, (2), ii, 108.
[8] Creuzer, (1), i, 779; Cumont, (3), 130 f.; Gasquet, 43.
[9] Dieterich, (2), 11.
[10] Hertel, (3), vii.
[11] Boll, (1), 308; Dieterich, (2), t.p., 46; Hüsing, *A. Rel.*, iv, 350; E. Meyer, (1), iii, 40; Lippmann, (2), i, 348, thought that this is the origin of the symbol 5, Fig. 7, for the sun and gold.
[12] Cumont, (3), 135, Fig. 1.
[13] Bousset, (1), 123, 135; Cumont, (3), 107, 141, 146; J. Kroll, (1), 184.
[14] Cumont, (3), 146; Dill, (1), 600 (Orphic + Chaldaean).
[15] Eisler, (3), 9; Gressmann, (1), 148.
[16] As in the *Avesta*, SBE, xxiii, 88.
[17] Cumont, (3), 135 f., 141, 146 f.; Dieterich, (2), 103. The later ceremony of taurobolism, described by Prudentius (A.D. 348–*c.* 410) is not truly Mithraic but derived from the cult of the Mother Goddess in Asia Minor: Gasquet, 67 f., 74 f.; H. Graillot, Le Culte de Cybèle, Mère des Dieux, dans l'Empire Romain, BEFAR, 1912, cvii, 150; Halliday, 291, 306.

to the Pythagoreans, Orphics, and the Sethian gnostics.[1] In another myth, an arrow strikes a rock and a fountain gushed forth;[2] perhaps fire produced by percussion, but interpreted by Neoplatonists as the light of dawn breaking over eastern hills.[3] In some cases the rock is wrapped with a serpent representing Aion.[4] The 'Mithraic mystery' of the 'stone which is not a stone' (μιθριακὸν μυστήριον του λίθου ὅς οὐ λίθος) appears in Greek,[5] and is a commonplace in later alchemy.[6]

Herodotos (*c.* 430 B.C.)[7] says the Persians have no images of god and no temples. They sacrifice to Zeus, the name they give to the whole circle of the sky, to the sun and moon, to the earth (γῆ), fire (πῦρ), water (ὕδωρ) and the winds (ἀνέμων). The element air (ἀήρ) does not appear, and neither the early Persians nor the early Hindus had any idea of the existence of the atmosphere, but only of moving air,[8] yet in some Persian texts the god of the air (Vāyu) is distinguished from the god of wind (Vāta).[9] The Persians probably did not worship what St. Paul[10] calls 'the beggarly elements' (τὰ πτωχὰ στοιχεῖα) themselves, but the gods of the elements.[11] Clement of Alexandria,[12] quoting Nymphodoros (4 cent. B.C.), says the Persians, Sauromatians (a Scythian tribe), and the Magi worshipped the elements. The meaning of 'elements (στοιχεῖα)' changed early in the Christian era to include stars, planets, and the zodiac, and later it became equivalent to demonology.[13] Strabo[14] gives the same elements as does Aristides (2 cent. A.D.), who says the 'Chaldaeans worship the elements (στοιχεῖα), which are the sky, earth, water, fire, moving wind (ἀνέμων πνοή), the sun, and moon.'[15] Al-Bīrūnī (A.D. 1000)[16] says the Persians before Zoroaster worshipped the sun, moon, and planets, and the remaining elements, all represented by idols, which may be correct.[17] ψ-Clement[18] says the initiates (of Mithra) swore by the sky (οὐρανός), earth, water, and air (ἀήρ), fire (πῦρ) being missing. In lists from Gnostic (related to Ebionites) and other sources air (ἀήρ) and ether (αἰθήρ), appear and 'holy spirits' (πνεύματα ἅγια) in the old sense of 'breath' replace winds (ἄνεμοι).[19]

On Mithraic altars the four elements are represented as fire = lion, earth = serpent, water = a jar, blowing winds = four (or two) heads at the corners.[20] There is a struggle of the elements, which continually devour one another,

[1] Brugsch, (1), i, 106; Cumont, (1), 48, 116; *id.*, (3), 132; *id.*, (6), 3046; Gasquet, 38; Legge, (1), ii, 242; Nilsson, *A. Rel.*, xi, 543; Zeller, (1), 1876, i, 78, 82.
[2] Dill, (1), 605; Legge, (1), ii, 242.
[3] Dill, (1), 607; Gasquet, 38, 54.
[4] Gressmann, (2), 26.
[5] Berthelot, (2), ii, 114 (Zosimos, from the Persian Komarios); Eisler, *A. Rel.*, xv, 312.
[6] ψ-Avicenna, in Berthelot, (4), i, 298; R. Bacon, ed. Brewer, 1859, 547; Eisler, (1), 411, 449, 524; (3), 136 f.; Hoffmann, in Ladenburg, (1), ii, 547; Manget, (1), i, 494 (Turba), 622 (ψ-R. Bacon), 633 (ψ-Avicenna), 935 (ψ-Lull), etc.
[7] i, 131.
[8] Hertel, (3), 62.
[9] Bousset, (1), 223.
[10] Gal., iv, 9.
[11] Bousset, (1), 224; Clemen, *A. Rel.*, 1913, xvi, 101; *id.*, PW, xiv, 509; Cumont, Ro., ii, 3044; Diels, (2), 44 f.; Pallis, (1), 93.
[12] *Exhort.*, 5; ANL, iv, 67.
[13] Bousset, (1), 226; Cumont, (1), 121, 283; (2), 57; (3), 193; Diels, (2), 44; Wendland, 158.
[14] XV, iii, 13.
[15] Bousset, (1), 224; Dieterich, (2), 55.
[16] (1), 186, 315.
[17] Reitzenstein, (5), 162.
[18] *Homil.*, ed. Dressel, 1853, 6.
[19] Bousset, (1), 227–9; Dieterich, (2), 63, 117 f.; Reitzenstein, (7), 70 f.
[20] Bousset, (1), 225; Cumont, (1), 283; (3), 117; Ro., ii, 3044.

and the world will end in a universal conflagration.[1] These are Stoic ideas.[2] Dio Chrysostom (*c.* A.D. 100) says the Magi in old hymns spoke of the chariot of the highest god, with four horses of different colours representing the four elements: fire (Zeus), air (Hera), water (Poseidon), and earth (Hestia).[3] Mithra rose to heaven in a quadriga and became ἀνικητος, *invictus*, *insuperabilis*.[4] In the Roman period, the elements were regarded as animated by souls (*spiritus elementorum*), worshipped by Julian.[5] The Iranians distinguished as many as five kinds of fire, including 'cold' and 'dark', always material and personified, but 'boneless'; in Manichaeism there are two kinds, good or open and evil or concealed.[6]

Iranian influence on Orphicism may be shown by the elements: earth, heaven, wind, fire, sea (=water), sun, and moon, which Aristides (2 cent. A.D.) gave as 'Chaldaean' but added the primal man to make eight. Zenobios (2 cent. A.D.) omitted wind and added Mithra and Night. A later form (*Rhind Papyrus*) of the Egyptian *Book of the Dead* has five elements: sun, moon, air, water, and fire, but these are 'variable' and not Empedoklean elements. In the *Mithras liturgy* (see below) the four divine elements compose a 'complete body (σῶμα τέλειον)' or 'complete nature (φύσις τελεία)' for the adept.

The so-called *Mithras Liturgy*[7] describes the ascent of a soul to heaven and a vision of Mithra. It is not a 'liturgy' or even Mithraic, although it has some Persian features (e.g. the vision of Mithra in a white chiton, scarlet cloak, and fiery crown; and perhaps the element theory), but is a Greek-Egyptian recipe for procuring immortality (ἀπαθανατισμός) and individual salvation.[8] It mentions Christ twice as 'the god of the Jews', also Abraham, Israel, and Jacob.[9] There are only 3 (or 4), not 7, heavens.[10] The 'middle air (μέσον τοῦ ἀέρος)' is the Stoic *crassus aer*,[11] as is also the 'divine mixture' τὸ εἰς ἐμὴν κρᾶσις θεοδώρητον.[12] The sublunary world, including man, is composed of pneuma (πνεῦμα), fire (πῦρ), water (ὕδωρ), and earthy substance (οὐσια γεώδης).[13] Above the pole and fixed stars is the god of the highest heaven, ὕψιστος θεός,[14] who turns the heavens in a direction opposite to that of the planets (κινοῦσα καὶ ἀντιστρέφουσα), as in ψ-Aristotle's περὶ κόσμου which is perhaps based on Poseidonios.[15] The doors of heaven are not superimposed but side-by-side, and to secure passage the guardian archons must

[1] Cumont, (1), 159; (3), 119; Reitzenstein, (13).
[2] Dieterich, (2), 156, 170, 173.
[3] Bousset, (1), 224; in early Greece, Poseidon was sometimes manifested in water, Demeter in earth, and Zeus in air: Farnell, 110.
[4] Cumont, (3), 129 f., 143.
[5] Cudworth, ii, 249.
[6] Bousset, (1), 225, 230; Hertel, (3), xxii, 7 f., 9, 14, 20, 29, 48, 61 f., 65, 77. Element worship is not ancient Egyptian, but is suggested in the *Hermetic Books* and occurs in an Egyptian hymn to the sun of the Persian period: Reitzenstein, (5), 165. In Scottish-Gaelic incantations there are seven elements: fire, air, earth, water, snow, ice, and wind (perhaps lightning): Carmichael, *Carmina Gadelica*, Edinburgh, 1928, ii, 349.
[7] BN Magic Papyrus *Suppl. grec* 574; *c.* A.D. 300, using material of *c.* A.D. 100; Bousset, *A. Rel.*, iv, 167; *id.*, (1), 314; Cumont, (1), 261; Deubner, Ro., iii, 2091; Dieterich, (2), 46; Lafaye, *Conf. Mus. Guimet*, 1906, xviii, 98; Legge, (1), ii, 255; PGM, i, 88; Preisendanz, *A. Rel.*, xvi, 549; Reitzenstein, (4), 1927, 169, 174–6; Schultz, 83; J. A. Stewart, (1), 365.
[8] Jones, ERE, viii, 752; Nock, (1), 231; Wesendonk, (1), 104.
[9] Dieterich, (2), 45–6.
[10] Bousset, *A. Rel.*, iv, 234; Dieterich, (2), 191.
[11] Dieterich, (2), 201 f.
[12] *Ib.*, 58.
[13] *Ib.*, 55, 57.
[14] Eisler, (1), 746.
[15] Dieterich, (2), 79, 87.

be given magic words.[1] The ascent of the individual soul is foreign to the old Iranian religion[2] and may be Babylonian,[3] or probably Greek,[4] or perhaps Orphic.[5] The ascent of the 'soul' to heaven was not prominent in Ancient Egypt, but was known.[6] It occurs in the Persian legend of *Ardā Virāf* (6 cent. A.D.),[7] and the Persian poet Niẓāmī (d. 1198), in his *Haft Paikar*, makes Muhammed put off an evil world propensity in each planetary sphere of his ascent.[8]

Mithraic representations show the seven planetary gods as such[9] or as stars, crosses, flaming altars, swords (perhaps of seven metals) stuck into the ground, trees, and vases.[10] In a Mithraic cave at Ostium the floor is divided into seven circles.[11] The twelve signs of the zodiac are shown in their traditional forms.[12] In the Sāsānid period (from A.D. 274) astrology flourished among the Persians, who may have transmitted it to the Mandaeans.[13] The purely mythical old Persian king al-Ḍaḥḥāk is said in the *Fihrist* (A.D. 987) to have erected temples to the seven planets.[14] The *Haft Paikar* of Niẓāmī (1140–1202) says the Shah Bahrām Gūr (5 cent.) built seven castles with the colours of the planets, inhabited by the seven daughters of the masters of the climates of the planets; he ordered his life according to the sequence of ruling planets.[15] A marble head of Mithra found in the Baths of Caracalla has seven openings so that when a light is placed behind, these appear as seven flames illuminating the hair.[16] In the *Bundehish* the five planets are Tīr (Mercury), Vāhrām (Mars), Aūharmazd (Jupiter), Anāhīd (Venus), and Kēvān (Saturn), the Sun and Moon, which in old Persian ideas are good spirits, are not included. To make up the seven, a star Gōkīhar and a 'thievish' Mūspar (perhaps a comet) are added. Each of the seven is ruled by a good star spirit, Mūspar by the Sun.[17]

The early Zoroastrians had no idols. Berossos[18] says these were first made in the time of Artaxerxes Mnemon (*c.* 436–359 B.C.), a polytheist; and there were probably idols of the elements in the Mithraic caves.[19] There may have been idols of the seven planets or their gods in niches closed by doors, or as a Septizonium.[20]

The famous Mithraic relief from Modena, with the figure of a god wrapped in a serpent and surrounded by flames and the signs of the zodiac, with two halves of an egg above and below, may represent the Orphic god Phanes,[21] or

[1] *Ib.*, 35. [2] Hertel, (3), 12, 43, 237; F. Spiegel, (1), ii, 159; Wesendonk, (1), 141.
[3] Bousset, *A. Rel.*, iv, 236; Cumont, (1), 126, 253.
[4] Capelle, *A. Rel.*, 1927, xxv, 245 (250); Dieterich, (2), 194 f.
[5] Eisler, (3), 64. [6] Kees, *Vostr. Bibliothek Warburg*, 1928–9, 1.
[7] Scheftelowitz, *A. Rel.*, 1921, xix, 213.
[8] Horowitz, *Islam*, 1919, ix, 159; Richter, *ib.*, 1921, xv, 113.
[9] Cumont, (3), 122.
[10] Bousset, (1), 25; Eisler, (1), 293, 472; Roscher and Boll., Ro., iii, 2538.
[11] Bousset, (1), 318. [12] Cumont, (3), 123–5.
[13] Cumont, (6), 3057–76; Pallis, (1), 20.
[14] Boll, (1), 10; Dieterich, (2), 55. [15] Ritter, *Islam*, 1926, xv, 111.
[16] Dibelius, q. in *A. Rel.*, 1925, xxiii, 314; cf. Reitzenstein, (7), 116, 122, 137; Wesendonk, (1), 47.
[17] Bousset, (1), 41. [18] I. Cory, (2), 69; from Clement of Alexandria.
[19] Bousset, (1), 225; Jeremias, 202; E. Meyer, (1), iii, 127; Réville, 79, 90; Wesendonk, (1), 98.
[20] Bousset, PW, vii, 1522, 1536; *id.*, *A. Rel.*, 1901, iv, 167, 248, 263; Cumont, (1), 126, 164, 198, 269; *id.*, (3), 125–7; Dieterich, (1), 106; *id.*, (2), 10, 12, 70 f., 89; Reitzenstein, (5), 35.
[21] Eisler, (1), 400 f., Fig. 47; *id.*, (3), 2 f., 73, Fig. 28, plate iv.

Kronos.[1] The idol shown in Mithraic representations with a lion's face, the body wrapped in a snake with its head on the lion's head, carrying a torch and a key, and apparently fitted with tubes to make fire come from the mouth, may represent Aion (*Αἰών*), Kronos or Saturn, the Iranian Zurvān Akeranana, or perhaps the Stoic Destiny (*Εἱμαρμένη*).[2] In form the representation corresponds with the description of the Manichaean and Mandaean Prince of Darkness (the Mandaean Ur or Leviathan), the Behemoth of Job,[3] and the demon blackened by soot, emitting fire from his mouth and sulphur from his nostrils, in the N.T. apocryphal *Martyrdom of Bartholomew*.[4] It has also been identified with Mithra, Helios, Sarapis, a fire or sun god, or a mixture of gods,[5] and may be of Babylonian origin,[6] or it may represent the evil power Ahriman which was afterwards worshipped.[7] A late Babylonian (Chaldaean) origin[8] is now doubted, and an Iranian and perhaps Greek (Orphic) source favoured.[9]

The Mithraic pantheon was reconstructed by Cumont[10] from material in Damaskios (*c.* A.D. 525),[11] based on Eudemos of Rhodes (*c.* 325 B.C.),[12] and late Persian sources.[13] At the head was a god called Kronos by Damaskios, who engendered all the other gods; the supreme triad of gods, equated with Greek gods, personified the sky (Jupiter), earth (Juno), and ocean (Neptune), and from them came the Olympian gods, which were identified with planets; the Persian Sharēvar, presiding over metals was identified with Mars.[14] The Middle Persian (Pahlavī) text *Bundahishn* (formerly read *Bundehesh*)[15] was edited in the 7 cent. A.D. but (as Götze showed) contains material from an old *Dāmdād-Nask*, which Schaeder says may be as old as 500 B.C. Similar information is contained in other Pahlavī texts.[16] In the *Bundahishn* the sky, metal, wind, and fire are male; water, earth, plants, and fish are female; the rest of creation is male and female.[17] To purify metals which have been defiled, gold and mercury are washed once, silver twice, iron three times, and steel

[1] Cumont, (3), 109; Dieterich, (2), 45, 66, 85; Legge, (1), ii, 242; Wünsch, *A. Rel.*, xiv, 539; xv, 302. A similar relief was found at Housteads: Eisler, (1), 411, Fig. 48.

[2] Bidez, (1), 220; Cumont, (3), 106, 235; (4), i, 74, 80; ii, 213 f., 238, 400 f., 407; (6), 3038, Gasquet, 41.

[3] Reitzenstein, (5), 79 f.

[4] ANL, xvi, 437.

[5] Dieterich, (1), 53 f.; Gasquet, 41.

[6] Wesendonk, (1), 65, 75.

[7] A. B. Cook, ii, 664, 1053; Legge, (1), ii, 252; Mead, (1), 399 f.

[8] Deubner, Ro., iii, 2091; Eisler, (1), 398 f., 412 f., 475, 507; *id.*, (3), 73; Gressmann, (2), 24; Mead, (1), i, 399; Reitzenstein, (2), 76.

[9] Cumont, (3), 107; Junker, *Vortr. Bibl. Warburg* (1921–2), 1923, 125 f.; Kaerst, ii, 239; Reitzenstein, (7), 81, 100, 353.

[10] (3), 106 f.; *id.*, (6), 3038 f.; Bousset, (1), 44 f.; Christensen, (2), 45 f.; Jones, ERE, viii, 758; H. S. Nyberg, *J. Asiat.*, 1931, ccxix, 1, 193.

[11] Damaskios, *De Principiis*, 125; tr. Chaignet, Paris, 1898, i, 347.

[12] Gressmann, (2), 9, 24.

[13] *Ulemā-i Islam*, in G. A. Vullers, *Fragmente über die Religion des Zoroaster*, Bonn, 1831; F. Spiegel, (1), ii, 178; West, SBE, V, lxx, 160.

[14] Cumont, (3), 110 f.

[15] Wesendonk, (1), 9, says it should be *Zandākās*.

[16] *Bundahishn*, 15, SBE, 1880, v, 52 (ed. E. W. West); *Zātspram* (*c.* A.D. 881) (i.e. *Vichitakīhā-i Zatspram*, 'selections' of Zātspram), 10, 1, SBE, 1880, v, 183 (H. W. Bailey, (1), 105, says it uses Hippokratic material); *Dādistan-i Dīnīk*, 64, 7, SBE, 1882, xviii, 199; Bousset, (1), 205 f., 218; J. Denner, *A. Rel.*, 1937, xxxiv, 254 (269); A. Götze, *Z. Indol. Iran.*, 1923, ii, 60, 167; Christensen, (1); the *Bundahishn* was translated (as the *Sad-der*) by Thomas Hyde (1636–1703), *Historia Religionis Veterum Persarum, necnon corum Magorum, liber Sad-der, Zoroastris præcepta, seu Religionis Canones continens*, 4°, Oxford, 1700; used by Gibbon, ch. viii.

[17] SBE, v, 61.

four times. Pearls, amber, and gems are 'washed like wood'.[1] Iron and, especially, lead are base metals.[2] Men are purified in a bath of molten metal, which to the righteous feels like lukewarm milk.[3]

A part of the *Bundahishn*[4] which Schaeder thought was taken from the *Dāmdād-Nask* gives a legend of a primeval man Gayōmard (or Gayōmart), who was killed by the evil spirit Beelzebul of the planet Saturn.[5] When Gayōmard died his seed fell on the earth and was purified by sunlight. Part was kept by Nēryō-sang (an angel of Ahura Mazda) and part by Spendarmad (spirit of the earth), and after forty years a Reivas plant grew from them, containing the first pair of mankind, Mashya and Mashyand, and human life began. The ground on which Gayōmard died is gold and on other lands, where his limbs dissolved, the various kinds of metals grew like weeds. From his limbs came the seven metals: from the head came lead (*srubh*; or *srup*), from the blood tin (*archich*), from the marrow silver (*sēm*, *asēm*, *sīm*, *asūn*, or *asēmēn*), from the feet bronze (*asīn*), from the bones copper (*rōdh*, or *zōd*), from the fat *āvgīnag*, from the flesh steel (*pōlābhadh*, or *pōlābad*), and from the soul, as embracing all, gold (*zarr*). West translated *āvgīnag* as mercury, but this is properly *zivag* or *sīmāb*, and Reitzenstein[6] translated *āvgīnag* as glass. In other accounts the relations and order are different and the translations vary. Christensen[7] adopted mercury (vif argent) and added as eighth diamond (diamant).[8]

Another divinity mentioned in the *Bundahishn* is Sharēvar (Šarēwar, or Šathrēvar). Al-Bīrūnī (A.D. 1000)[9] says 'Shahrēwar means sperma and love; he is an angel appointed to watch over the seven substances, gold, silver, and the other metals, on which all handicrafts depend and in consequence all the world and its inhabitants'. The *Bundahishn* says of Sharēvar: 'of material creatures he took to himself the metals . . . for the solidity (or hardness) of metals (*gēn ayō-khshusta*) is from the sky and the original substance of the sky is metal or crystal (*ayō-khshust*).'[10] H. W. Bailey[11] says the *Bundahishn* gives as the eight metals formed from the body of Gayōmart: *srubh* (lead), *archīch* (tin), *sēm* (silver), *āsen* (iron), *rōdh* (copper), *āpagēnak* (crystal), *pōlābhadh* (steel), and *zarr* (gold). *Zatspram* reads *asēm* for silver, the rest are the same. In the *Bundahishn*, Ōhrmazd 'created minerals within the earth, and mountains which afterwards sprang forth and grew out of the earth. And to aid the earth he gave it iron (*asān*), copper (*rōd*), sulphur (*gōgarth*), and soda (*bōrak*, tr. "borax" by Zaehner) and all the other hard substances except

[1] *Ib.*, 273. [2] *Ib.*, 285.
[3] *Ib.*, 126
[4] *Ib.*, 52.
[5] Duval, *J. Asiat.*, 1893, ii, 290 (300); Reitzenstein, (7), 192.
[6] (7), 225, 228.
[7] (3), 1918, 22, 25–6, 52, 62.
[8] Schaeder, (1), 201 f., 211, said Gayōmard should be Gayōkmart (Arabic Kayūmart), which Christensen said is 'absurd', and *Bundahishn* is *Zandāgāsih* (Doctrine of Tradition), the description of eight metals as parts of the body of Gayōmard is probably Babylonian.
[9] (1), 207.
[10] Zaehner, (1), 323 ll. 67–71; tr., 335; Nyberg, (2), 235, gives a different translation: also *Ib.*, 223, 'the sky is of flaming iron called steel.'
[11] (1), 131.

styhl, for that is of a different substance.'[1] Ōhrmazd said: 'I created the sky of the substance of the bright (*khwaēna*, or *khwaina*) metal';[2] Ōhrmazd 'asks the bones from the earth, blood from the water, hair from the plants, and soul (*jān*) from the wind;[3] he created the sky from his head, earth from his feet, water from his tears, plants from his hair, fire out of his mind.[4] In the *Avesta* the sky is of *ayah*, understood by commentators to mean iron (*āsen*) or silver (*asēmēn*); the Pahlavī *ayōkshust*, from the Avestan *ayō-khshusta* (molten metal), can also mean crystal (*āpākenak*).[5] In old Persian and Pahlavī texts there is no trace of the association of the planets with metals.[6]

The *Nuzhat-nāma-i 'Alā'i* of Shāhmardān ibn Abī-'l-Khayr, completed *c.* A.D. 1095–1119, and its supplement the *Faraḥ-nāma-i Jamālī* (also called *Farrukh-nāma*), completed in A.D. 1163, or 1184, or 1201 by Abū Bakr ibn al-Muẓhir ibn Muhammad al-Jamāl al-Yazdī, are ostensibly encyclopaedias of science, but contain superstitions of the inorganic and organic world, divination, astrology (prayers to the planets, with appropriate kinds of incense), magic, charms engraved on rings, mysteries of numbers, etc. They preserve pre-Islamic popular Persian beliefs.[7]

[1] Zaehner, (1), 323 ll. 67–71; tr., 335, says *styhl* is 'a form of plant which by its hardness or some other property may be classed with metals', which seems improbable. Gayōmard appeared later.

[2] H. W. Bailey, (1), 93, 128.

[3] *Ib.*, 97; *Rivāyat* of the *Dātastān-i dēnīk.*

[4] *Ib.*, 102 f., from the *Rivāyat.*

[5] *Ib.*, 125 f., 132. The Sanskrit *tikṣṇaloha*, steel, is equivalent to *khwen āsen*, an alternative meaning of almās (diamond), which in *Zatspram* means steel: *Ib.*, 134. Nyberg, (2), 230. 8, 295, has: 'Ormuzd revêtit aussi de la bonne atmosphèro, robe d'or et d'argent, ornée de pierres precieuse et de toutes sortes de couleurs rouges (?), l'habit des guerriers.'

[6] Darmesteter, q. by Duval, *J. Asiat.*, 1893, ii, 290 (300).

[7] W. Ivanow, JRAS, 1929, 863–8; *Isis*, 1930, xiv, 477.

CHAPTER XVII

MANDAEISM

The Mandaeans (Mandāyē) are a gnostic sect of baptists at present living in 'Irāq near Baṣra and Mosul (Mawṣil), also in Damascus and Hillaḥ.'[1] They are mostly wood and brass workers.[2] Their moral precepts are good, but they tolerate polygamy and practise magic.[3] They now speak Arabic but their books are in an Aramaic dialect similar to that in the Babylonian *Talmud*, written in an unusual script in which vowels are represented by letters.[4] The Mandaeans believe that their sect goes back to the creation of man.[5] They are not the Sabaeans of Classical authors, who were the inhabitants of Saba' in the Yaman.[6]

An early account of Mandaeans is that by the Italian Carmelite friar Ignazio de Gesù (Ignatius à Jesu).[7] Ignatius called them 'Christians of St. John [the Baptist]', but they are not Christians. The text of their main book, the *Ginza* (Treasure), was edited and translated by M. Norberg,[8] who incorrectly called it 'The Book of Adam'. J. H. Petermann, who lived among them and obtained information from a priest, published the text.[9] N. Siouffi, French Vice-Consul

[1] Anz, 70–8; G. Bardy, DTC, 1926, ix, 1812–24; Bousset, (1), 28–41, 115, 231, 242; A. J. H. W. Brandt, (1) *Die mandäische Religion ihre Entwickelung und geschichtliche Bedeutung*, Leipzig, 1889 (Schaeder, (2), 123, says it is 'essentially correct'); (2) *id.*, Die Mandäer, ihre Religion und Geschichte, in *Verhl. K. Akad. Wetens. Amsterdam, Aft. Letterkunde*, 1915, xvi, no. 3; (3) *id.*, ERE, viii, 380–93; Budge, (4), 239 f.; R. Bultmann, *A. Rel.*, 1926, xxiv, 103; F. C. Burkitt, (3), (5); R. P. Casey, in *The Background of the New Testament and its Eschatology, in honour of C. H. Dodd*, ed. W. D. Davies and D. Daube, Cambridge, 1956, 52 (crit. Reitzenstein); Dodd, (2), 102, 115–30; E. S. Drower, *The Mandaeans of Iraq and Iran*, Oxford, 1937; Hitti, 357; A. V. W. Jackson, (2); K. Kessler, (1), (2), (4); C. H. Kraeling, (1) A Mandaic Bibliography, *J. Amer. Orient. Soc.*, 1926, xlvi, 49–55; (2) *id.*, The Origin and Antiquity of the Mandeans, *ib.*, 1929, xlix, 195–218; (3) *id.*, The Mandaic God Ptahil, *ib.*, 1933, liii, 152–65; *id.*, (4); M. J. Lagrange, La Gnose Mandéenne et la Tradition Évangélique, in *Rev. Biblique*, 1927, xxxvi, 321, 481; 1928, xxxvii, 5; 1929, xxxviii, 137; S. Lane Poole, (1), 242 f., 268 f.; M. Lidzbarski, (1) *Das Johannes buch der Mandäer*, ed., tr., and comment., Giessen, 1905–15; (2), *id.*, Mandäische Liturgien, in *Abhl. K. Ges. Wiss. Göttingen, phil.-hist. Kl.*, 1920, xvii, Abt. 1 (text, tr., comment.); (3) *id.*, *Ginzā, der Schatz, oder das grosse Buch der Mandäer, übersetzt und erklärt*, Göttingen and Leipzig, 1925; Loisy, (1); G. R. S. Mead, *The Gnostic John the Baptizer. Selections from the Mandæan John Book*, 1924; E. Meyer, (2), ii, 425; T. Nöldeke, (1) *Mandäische Grammatik*, Halle, 1875, Intr., xix–xxxiv; *id.*, (2) *A. Rel.*, x, 151; S. A. Pallis, (1); J. T. Parfit, *Marvellous Mesopotamia*, 1920, 154; E. Petersen, (a) *Z. neutest. Wiss.*, 1926, xxv, 236; (b) *id.*, *ib.*, 1928, xxvii, 55; H. Pognon, (1); H. C. Puech, (1); H. R. Reynolds, DCB, iv, 569–73 (Sabians); Reitzenstein, (5), (6), (7), (10), (11); H. H. Schaeder, (1), (2); J. Thomas, 184–267; Tondelli, (1), 82; Wesendonk, (1).

[2] G. C. M. Birdwood, in Goblet d'Alviella, (1), xv; S. Lane Poole, (1), 287.

[3] J. Thomas, 195–6, 207.

[4] Budge, (4), 239 f.

[5] S. Lane Poole, (1), 274.

[6] *Ib.*, 253; Hitti, 49 f.

[7] *Narratio Originis, Rituum & Errorum Christianorum Sancti Ioannis* . . . , 8°, Rome, typis sacr. cong. propag. fidei, 1652; edited from material collected by missionaries.

[8] *Codex Nasareus, Liber Adami appellatus*, 3 pts., Copenhagen, 1815–16; French tr. in Migne, (2), 1856, i, 3 f.

[9] *Thesaurus sive Liber Magnus vulgo Liber Adami*, 2 vols., Leipzig, 1867.

at Mosul, published the results of conversations with a converted Mandaean youth (whom he calls a 'professeur').[1] New information came from ink inscriptions on cups or bowls found in large numbers in 1894, usually buried inverted to imprison evil spirits.[2] Similar bowls were found in the mounds at Hillaḥ, on the site of ancient Babylon.[3]

The *Ginza* is a collection of fragments compiled at various dates from documents now lost; the earliest may be 1 cent. A.D., but probably 2–3 cent. The present form is 7–8 cent. (it mentions Muḥammad). It is in two parts, Right-hand (GR, longer) and Left-hand (GL).[4] It was probably produced so as to have a 'book' to secure tolerance under Muslim rule, John the Baptist (Aramaic Joḥanā, Arabic Yaḥya) being brought in as a 'prophet'; he plays a very minor role in the texts,[5] which are full of contradictions.[6] Besides the *Ginza* (sometimes called *Sidrā Rabbā*, Great Book) there is a *Sidrā d'Yahyā* (Book of John [the Baptist]), a *Drāshē d'Malkē* (Discourses of Kings; a later work) and the Qolāstā (from the Arabic *qall*, 'quintessence' or 'choice') which is a collection of hymns and discourses.[7] A *Diwān* mentioned by Ignatius is a gnostic work containing numerous diagrams like those in magic papyri, written on a long strip of paper.[8] The *Asfar Malwāshā* (Book of the Zodiac) is astrological and contains Persian, Arabic, and Jewish elements of various dates.[9] The Mandaeans were related to the old Jewish sect of the Elchasites in Syria, who were known in the 3 cent. A.D.[10] Hippolytos reported that they practised baptism by repeated immersion, and believed in astrology and magic; they invoked 7 'witnesses (μάρτυρας)': sky or heaven (οὐρανὸς), water, holy spirits (πνεύματα τὰ ἅγια), angels, oil (τὸ ἔλαιον), salt, and earth (γῆ), and recited a formula. Epiphanios has salt, earth, bread (or wheat), sky, ether, and wind; he says the Elchasites attributed sex to everything, including plants, fire (πῦρ, female), and water (ὕδωρ, male).

Chwolsohn identified the Mughtasila (Washers) in the Fihrist with the Elchasites, but they were the Mandaeans, called Subba (plural of Ṣābi, from the Syriac for 'washer'), the true Ṣābians of Arabic authors, the 'Chaldaean Ṣābians' of the marshes

[1] *Études sur la Religion des Soubbas, ou Sabéens, leurs Dogmes et leurs Mœurs*, 1880; Soubba = Baptist.

[2] Brandt, (2), 6; formerly dated A.D. 400 is A.D. 500: Albright, 281 f., 338; Budge, (4), 240 f. (amulets, including lead ones; one in the BM); Kessler, (1), 157 (bowls in BM); Pognon, (1); R. Stübe, *Judisch-Babylonische Zaubertexte herausgegeben und erklärt*, Halle, 1895 (bowls in Berlin Mus.).

[3] Layard, *Nineveh and Babylon*, 1867, 290; Legge, (1), ii, 32 f.; such bowls are mentioned by Juvenal, *Sat.*, iii, 13; vi, 541–6.

[4] Albright, 281, 338; Brandt, (1), 48, 59; (2), 35 f.; Budge, (4), 239 f.; Kraeling, (3); S. Lane Poole, (1), 265; Lidzbarski, (3), 222, 423; Loisy, (1), 15; E. Meyer, (2), ii, 425; Pallis, (1), 2 f.; Petersen, (*a*), (*b*); Reitzenstein, (5), 46, 65, 92; Siouffi, 50 f.; J. Thomas, 214 f., 220 f. (before 7 cent.); S. H. Taqizadeh, BSOS, 1938, ix, 603; Wetter, (1), 106.

[5] Brandt, (2), 43 f.; Budge, (4), 239 f.; Loisy, (1), 17, 27, 37, 44; J. Thomas, (1), 265 f.

[6] E. Meyer, (2), ii, 425; Pallis, (1), 2 f.; Siouffi, 50 f.

[7] Budge, (4), 239 f.

[8] Euting, *Mandäische Diwān*, Strasbourg, 1904; Alfaric, i, 6; Brandt, (3) (says it is puerile).

[9] Brandt, (3), 389; Budge, (4), 241.

[10] Alfaric, i, 5; Bousset, (1), 155 f., 228; Brandt, (1), 178; E. G. Browne, (2) (*a*), i, 302 f.; Carra de Vaux, (1), i, 147; (2), 63; Chwolsohn, i, 112, 116, 121 f., 136; ii, 15; Dozy, (3), 283; Duschesne, i, 94; Epiphanios, *Panar.*, XIX, XXX, LIII; (1), i, 40, 125, 461; Hippolytos, *Refut.*, i, 13 f.; x, 29; S. Lane Poole, (1), 252, 266; Nicholson, JRAS, 1906, 318; Nöldeke, *A. Rel.*, x, 151; Origin, in Eusebios, *Hist. Eccles.*, vi, 38 (ed. Burton, Oxford, 1838, i, 442); Puech, (1), 41; Salmon, DCB, ii, 95; J. Thomas, (1), 140 f., 151, 244 f., 252.

of Baṣra (where they were first found by the Arabs), who are mentioned in the Qur'ān.[1] They may be the 'Chaldaeans' mentioned by Hippolytos[2] in his account of the Naassene statue (ἀνδρίας) made from man's body by demons, the 'bodily pillar' of the Mandaeans.[3]

The first literary mention of the Mandaeans (as Dōstāje) is by Theodore bar Kōnai (A.D. 792)[4] who says Ado (Adam) was their founder and they borrowed from the Marcionites, Manichaeans, Kantaeans (a Babylonian-Iranian sect related to the Dositheans, founded in the 5 cent.) and Nergalians (named after the Babylonian god Nergal), who were idolators (perhaps Zurvānists, who were interested in Adam, the planets and zodiac, and had a saviour Abel, the Mandaean Hibil). The relation to the Marcionites was probably slender;[5] a strong influence by the Manichaeans[6] is disputed (see p. 321); influence from Mithraism[7] and the Nabataeans of 'Irāq[8] is possible. One view[9] is that Mandaeism developed from older Dosithaean, Marcionite, and Manichaean groups, inheriting Canaanite and Aramaean mythology on one side, and on the other Babylonian mythology and folk-lore, along with much pagan material from earlier syncrelistic sects.[10] In the *Ginza* the Mandaeans are called Nāṣōrājē (Nasaraeans), perhaps from the Hebrew Naṣrim, Aramaic Naṣeraja (observers [of the rites]), or *nazir* (pure). Reitzenstein thought this was connected with the oldest name of Jesus (ὁ Ναζωραῖος).[11] The Mandaeans may have originated in Palestine, east of the Jordan; they venerate the Jordan and in prayer turn to the north.[12] Al-Bīrūnī (A.D. 1000)[13] said they were Jews who remained in Babylonia after the captivity and some think they originated in S. Mesopotamia, where they now live.[14] Pallis[15] thinks the place of origin is unknown, and Burkitt[16] does not discuss it. They were opposed to orthodox Jews but probably adopted some late Jewish doctrines.[17] They speak of twelve false religions.[18] They regard Jesus as a Jewish prophet but oppose Christianity as a false revelation. They may have got to know it from Nestarian Syriac translations of the Bible or from some gnostic

[1] S. Lane Poole, (1), 264; H. Pederson, in *A Volume of Oriental Studies presented to E. G. Browne*, Cambridge, 1922, 382; J. Thomas, 1935, 206–10.
[2] *Refut.*, V, vii, 10 f.
[3] Brandt, (1), 36; Kessler, (1), 158, 163, 181; *id.*, (2), 554; Reitzenstein, (10), 94; *id.*, (5), 63.
[4] Loisy, (1), 19 f., 89 f., 145; Pognon, (1), i, 6; ii, 224.
[5] Loisy, (1), 92.
[6] Brandt, (2), 31; Loisy, (1), 93 f.; Reitzenstein, (12), 87, 265 f., 352 f., 384 f.
[7] Loisy, (1), 26.
[8] Lidzbarski, (3), vii.
[9] Albright, 281, 338; Puech, (1), 40, 123.
[10] On the Samaritan Dositheans, see K. Kohler, *Amer. J. Theol.*, 1911, xv, 404; J. A. Montgomery, *The Samaritans*, Philadelphia, 1907, 252–9; Salmon and Fuller, DCB, i, 902–5 and refs. J. Thomas, (1), 243 f., thought Dosithean relation to the Dositheans is slight.
[11] Bultmann, *A. Rel.*, xxiv, 103; Kessler, (1), 157, 159; E. Meyer, (2), ii, 408 f.; Reitzenstein, (5), vi; J. Thomas, (1), 243.
[12] Kraeling. (2); Lagrange, 1927–9; S. Lane Poole, 264; Lidzbarski, (3); E. Meyer, (2), ii, 425; Nöldeke, .-), xix–xxxiv; Reitzenstein, (7), 308; (10), 36 f., 59, 96; J. Thomas, (1), 214 f., 220 f.
[13] (1), 188.
[14] Albright, 281, 338; Brandt, (1)–(3); Loisy, 63, 65, 146 ('Jordan' is not a place).
[15] (1), 201 f.
[16] (5).
[17] Brandt, (2), 19, 29; Reitzenstein, (7), 307; (10), 15; Odeberg, (1), Intr., 43, 64 f., 79 f., 125 f.; tr., 8, 16, 30 f., 34, saw a relation with *Enoch III*.
[18] Lidzbarski, (3), 20.

sects, and were influenced by it.[1] That they were early enough to influence St. Paul[2] is improbable.[3]

Mandaeism is a debased form of gnosticism; the name may be derived from the Hebrew *mandā*, Syriac *mad'ā*, 'word' or 'knowledge', or (Reitzenstein) Hebrew *mānā*, 'vessel'. Babylonian (Chaldaean), Persian, Egyptian, Jewish, Christian, Greek (from Plato and later), and even Indian and Parsī, components have been detected in it.[4] The Mandaeans oppose idol worship and to some extent magic; they do not worship the stars but the priests interpret them and the people fear them.[5] Their principal ceremony is triple baptism (*masbothā*) in 'living' (i.e. running) water, 'the Jordan' and 'rivers coming from the far north'.[6] Bitterness and saltness are signs of evil, sweetness and freshness a sign of divinity.[7] The world is a mixture of good and evil, light and dark; evil is due to the powers of the planets, and salvation is effected by a divine being who descends from heaven and accompanies the soul on its upward journey through the planetary spheres.[8] These are typical gnostic ideas. Their cosmology and cosmogony are confused, and contradictory in different texts.[9] In the *Ginza* the principle of all is Pīrā rabbā, who arose from himself. He produced other beings, lastly P'tahil, the creator of the visible world, who partakes of the nature of matter.[10] Mānā rabbā also produced Kbar zīwā or Hibil zīwā, the messenger or logos, representing Adam the first man, and personified gnosis (γνῶσις τῆς ζωῆς).[11]

Opposed to the Kingdom of Light was a Kingdom of Dark ruled by the evil principle Ur,[12] associated with a female principle Rūḥā d'Qudšā, the Holy Spirit, ruler of the planet Venus.[13]

P'tahil created the world by throwing seven garments into the black water of the abyss.[14] From the primary matter, by the action of the water of life, Rūḥā formed the seven planets, which 'carry the seven lights of the world' on cars.[15] Hibil zīwā descended into the region of darkness and overcame Ur.[16]

[1] Bousset, *A. Rel.*, iv, 229, 245 f.; *id.*, PW, vii, 1505; Brandt, (1), 130 f., 140 f., 157; (2), 59; Burkitt, *J. Theol. Stud.*, 1928, xxix, 225; Duchesne, i, 409 f.; Loisy, (1), 60, 89 f.; Reitzenstein, (5), 66, 92; J. Thomas, (1), 217 f., 254 f.; Wesendonk, (1), 128.

[2] Reitzenstein, (5), 124, 130, 133; (7), 308; (10), 40, 59.

[3] E. Meyer, (2), ii, 407, 425.

[4] Alfaric, i, 4; Bousset, *A. Rel.*, iv, 229, 245 f.; *id.*, PW, vii, 1505; *id.*, (1), 158; Brandt, (1), 57, 64, 168, 176, 182, 187, 194, 202; (2), 14 f.; Burkitt, EB[14], 1957, xiv, 787; Dodd, (2), 120 f.; Dozy, (3), 290; Horowitz, 62, 121, 137; S. Lane Poole, 262 f., 267; Lidzbarski, (3), xi f.; Loisy, (1), 11, 21, 87 f., 101; Pallis, (1), 7, 20, 35, 42, 47, 50 f., 83, 87, 96 f., 115 f., 151 f., 160, 181, 210; Reitzenstein, (5), 92; (10), 87; J. Thomas, (1), 219; Wesendonk, (1), 128.

[5] Bousset, (1), 28; Brandt, (1), 115; (3), 386; S. Lane Poole, (1), 286; Lidzbarski, (3), x f., 15, 19, 49; Pallis, (1), 5.

[6] Kessler, (1); S. Lane Poole, (1), 278; Loisy, (1), 104, 106, 121 f.; Pallis, (1), 42.

[7] Reitzenstein, (5), 91; cf. the gnostic θάλασσα in Hippolytos, *Refut.*, v, 14.

[8] Anz, 70 f.; Bousset, (1), 39, 46, 51, 60, 75 f., 115; Lidzbarski, (3), 221, 223, 563, 578, 592.

[9] Drower, 73 f.

[10] Bousset, (1), 231; Brandt, (1), 34 f.; Kessler, (1); Kraeling, (3), 152 f.; Lidzbarski, (3), xxvii, 8, 10, 13, 31 f., 151; Loisy, (1), 14; Reitzenstein, (10), 96.

[11] Lidzbarski, (3), 32 f., 67, 151; Loisy, (1), 22; Reitzenstein, 1921, 53, 59.

[12] Bousset, (1), 29–30; Burkitt, (5), 787.

[13] Kessler, (1), 170; S. Lane Poole, (1), 273; Lidzbarski, (3), x f., 15, 49, 223; Lipsius, DCB, iv, 714; Loisy, (1), 24; Reitzenstein, (11), 88.

[14] Brandt, (2), 17; Lidzbarski, (3), 176, 351.

[15] Brandt, (1), 52, 61–3, 126, 128, 183.

[16] Lidzbarski, (3), 146 f., 150 f., 157–8, 161, 167, 169–70, 173, 319, 568.

Ur could not be destroyed, but was shut off from the upper world by seven circular walls, the earth in the shape of seven flat anvils of the seven metals resting on his stomach or head.[1] The lower world (earth) is separated from the upper by seven iron and seven golden walls, over which secret names were spoken so that no one could move them.[2]

Man consists of an outer body (*pagra*), the soul (=ψυχή), and spirit (=νοῦς) as the inner body of the soul.[3] In its passage upwards the soul must pass through the spheres of the seven planets, whose evil and half-evil demons did not take part in the creation but assist in its government.[4] The ascent (*masseqtā*) is past the guardians (*matras*) of the seven sentry-boxes (Wach-Häuser, postes de garde), stations, or 'prisons' (*maṭṭartās* or *maṭṭarāthā*) of the planetary regions. The soul gives its true name to the guardians, shows the signs, and with the aid of two angels (*utras*) who precede (or accompany) it, passes through all the regions.[5] The demons of the seven planets (dēws), which are each bringing a specific evil to mankind, have their Babylonian names as gods (given in brackets) and are in the following old astronimical order:[6] Sun, Shamesh (Shamash), sometimes Il; Venus, Libat or Dlibat (Dilbat), or Estra (Ishtar); Mercury, Nbu or Ebnu (Nebo), or Tus (Egyptian Thoth); Moon, Sin (Sin), or Saurel; Saturn, Kēwān; Jupiter, Bēl or Mardik (Marduk); Mars, Nergah or Nerig (Nergal). Release from the planetary powers will come only at the end of the world, when Ur will swallow the earth and the planets, will burst and fall into the region of darkness, where he will cease to be.[7]

In the Persian *Ardā Virāf* (6 cent. A.D.) the sun, moon, and stars are stations of *good* thoughts, protecting the soul (which goes through, not past, them) against evil spirits. The seven planets, heavens, walls, watch-houses, etc., are of Babylonian origin, but the planets, under Iranian and Manichaean influences, became evil demons.[8] The soul attains the Ogdoad and receives a 'clothing of light' of many colours.[9] Parts of the universe are related to parts of the body (sky=head);[10] the 'seven mysteries of the body' are perhaps the organs and their functions.[11]

Reitzenstein[12] detected Iranian sources for: (1) the Mandaean name

[1] Ignatius à Jesu, in Brandt, (1), 34, 52, 60, 128; *id.*, (2), 17; Kessler, (1), 171; Lidzbarski, (3), 198; Siouffi, 59; in the *Ginza* there are an anvil of copper, one of the world (on which it rests), anvils of water, and anvils of the 'fruits of the earth' (metals?); Lidzbarski, (3), 92, 143, 168, 193; eight 'earths or anvils' are mentioned in Turfan Manichaean texts: A. V. W. Jackson, (2), 72 f. and plate; Reitzenstein, (5), 60, 82, thought these texts mention only one iron *wall*.

[2] Brandt, (1), 52, 60; Lidzbarski, (3), 143, 153, 162, 164, 168, 551.

[3] Brandt, (1), 189; Kessler, (1), 171; Reitzenstein, (10), 88; *id.*, (5), 35, 106, who says the idea is Iranian.

[4] Brandt, (1), 34, 52, 60.

[5] Anz, 71; Bousset, *A. Rel.*, iv, 229 f.; Brandt, (1), 74, 175; Lidzbarski, (3), 183 f., 443 f., 446, 578 f.; Reitzenstein, (10), 25 f., 83 f.; *id.*, (5), x, 7, 10, 47, 59 f., 61, 72, 233.

[6] Anz, 70 f., 74–5, 78; Bousset, (1), 28–9; Brandt, (1), 52, 61, 126, 128, 182–3; Siouffi, 61, 144; Kessler, (1), 170; *id.*, (2), 554; Lidzbarski, (3), 25, 28 f., 43, 46, 52, 124, 176, 199, 205, 223, 312 f., 446; Pallis, (1), 5, 82 f., 178; Reitzenstein, (5), 34, 59 f.; *id.*, (10), 13, 36.

[7] Kessler, (1), 171; Reitzenstein, (10), 29.

[8] Reitzenstein, (5), 60, 64 f., 71.

[9] A central idea, perhaps related to the many-coloured garment in the Isis mystery in Apuleius; Lidzbarski, (3), 443 f., 503, 524 f., 526 f., 570 f.; Reitzenstein, (5), 95 f., 147, 164.

[10] Reitzenstein, (5), 50.

[11] Lidzbarski, (3), 202.

[12] (5), 37, 43 f., 67, 74; *id.*, (6), 9, 35 f., 40, 43.

Abāthūr for Hermes, (2) the 'great dragon' (perhaps the Babylonian Tiamat), (3) the ascent of the soul, and (4) the elements fire and water, although the old Iranian view (before the 4 cent. B.C.) that fire is good and male, and water is evil and female, was invented, as in some Christian gnostic sects of the 2 cent. The *Ginza*[1] says fire and wind come from the earth and are of the nature of 'the seven [planets]'. Other gnostic sects regarded fire and air as spiritual elements (*ψυχικὰ στοιχεῖα*) and water and earth as bodily elements (*σωματικὰ στοιχεῖα*), in relation to Greek philosophical ideas.[2] The Mandaean doctrine that everything was created from two fundamental elements, fire and water, may be derived from the Persian Zurvān doctrine; different kinds of fire are recognised, and in a late passage fire is said to be evil.[3]

[1] Lidzbarski, (3), 200. [2] Reitzenstein, (6), 62. [3] Pallis, (1), 74, 93 f., 101.

CHAPTER XVIII

MANICHAEISM

Mānī (his only true name) was born in Mardīnu, a village near Nahar-Kūthā in Babylonia 'in the year 527 of the Babylonian astronomers', which would be about A.D. 216.[1] His mother was of noble Arsacid race; his father, probably born in Hamadhān (old Ekbatana) in Media, had belonged to some baptist sect, perhaps the Elchasites (see p. 315); Mānī was probably educated by the Magi and by birth and upbringing was a Persian. In A.D. 224 the Arsacid was replaced by the Sāsānid dynasty. Mānī had read largely and absorbed something from many sources. He visited India but returned to Jundīshāpur at the invitation of Shāpur I. He announced his new religion in 242/3; it was intended as a reform of Zoroastrianism but incorporated foreign elements. He may have been in the army of Shāpur I which captured the Roman emperor Valerianus in 260; if he was in the army opposing Gordian in 243, as some accounts say, Plotinos was in the opposite camp.[2] Mānī went about preaching with 'a thick ebony stick in his right hand and a Babylonian book under his left arm'.[3] On his return to Jundīshāpur he was arrested, condemned for heresy and imprisoned in heavy fetters; he died in 276/7; legends of his execution, etc., are unfounded.[4] Mānī believed that he was visited by an angel and that he was the last of a succession of prophets: Hermes (part of the *Shepherd of Hermas* is mistaken for a book of Hermes in a Turfan text),[5] Zoroaster, and Jesus (who had a special place); the *Sibylline Books* were also greatly respected;[6] Zoroastrian, Christian, Buddhist (at least in the Turfan texts), Greek (Orphic, Pythagoras, Plato, perhaps Neoplatonism) and gnostic (Markion, Bardesanes) influences on Mānī have been assumed.[7]

Syria was then inhabited by Chaldaeans, Assyrians, Persians, Greeks, Jews, Christians, Gnostics, Ṣābians, and perhaps Mandaeans. Pre-Zoroastrian in-

[1] Alfaric, i, 16; Burkitt, (3), 3; modern authors give (all differently) the day and month.
[2] Puech, 47.
[3] *Acta Archelai*, 14; ed. Beeson, 22.
[4] Alfaric, i, 18 f., 22 f.; ii, 84; G. Bardy, DTC, 1926, ix, 1841–95 (Manichéisme); A. A. Bevan, ERE, viii, 394–402; F. C. Burkitt, (3); Dhalla, (1)–(3); Gressmann, (1), 157 f.; W. B. Henning in S. G. Champion, (1), 289; A. V. W. Jackson, (2); Fabricius, (1) (*b*), 1801, vii, 310–34; K. Kessler, (1) RPTK, 1903, xii, 193–228; *id.*, (2) *Mani. Forschungen über die Manichäischen Religion*, 1889, i (based on *Fihrist*); L. H. Kraeling, (1)–(4); H. Leclercq, DACL, 1931, x, 1390–1411 (Manichéisme); C. W. Mitchell, (1); Pognon, (1); H. J. Polotsky, PW, suppl. vi, 240; Puech, (1), 20 f., 23, 33, 35 f., 46–7, 51 f.; Reitzenstein, (4), (5), (7), (13); Schaeder, (2), 71 (d. A.D. 273); F. Spiegel, ii, 203; F. Spiegelberg, (1), 387 (Zoroaster), 451 (Mānī); G. T. Stokes, DCB, iii, 792; Wesendonk, (1)–(3).
[5] Plessner, *Islam*, 1927, xvi, 105.
[6] Alfaric, i, 21, 45, 73; ii, 201 f., 205; Burkitt, (3), 37 f., 96, 98; Puech, 62, 144.
[7] Alfaric, i, 17 f., 48 f.; ii, 197 f., 205 f., 211 f.; Burkitt, (3), 72–6, 80, 84, 97–8.

fluence in Egypt and Greece[1] may have been overestimated.[2] Manichaeism has been supposed to be purely Oriental, with a basis of Hellenistic science, and a completion of gnosticism, with important Persian and Christian[3] elements;[4] Babylonian have been emphasised[5] and minimised.[6] Buddhist, at least in Far Eastern and Middle Persian texts, is probable,[7] and some Jewish elements through the magic papyri.[8] Relations with Mithraism[9] and Mandaeism (see p. 305)[10] are uncertain.

Between 1897 and 1907 some Manichaean texts were discovered at Turfan in Sinkiang, Chinese Turkestan; they had worked up through the sand of the Gobi Desert and were used by villagers for stopping draughty windows.[11] The Uyghur kingdom, with its capital at Turfan, was the only nation to adopt Manichaeism officially.[12] The Turfan texts are in Soghdian (a form of Middle Persian), Proto-Turkish, and Chinese; the Turkish are written in inks of various colours in an elegant script peculiar to the Manichaeans.[13] A peculiar script and the beautiful appearance of the books are old traditions. The *Fihrist* mentions the script, derived from Persian and Syriac, and it was used (10 cent.) in Samarqand and Transoxania by Markionite gnostics.[14] Al-Bīrūnī (A.D. 1000)[15] knew that Mānī's teachings were propagated among the eastern Turks and in parts of India, China, and Tibet, and were still held in his time. Two works of Mānī, *The Book of Three Times* (past, present, and future) and *The Book of Two Roots* (light and darkness, or God and matter) are in Chinese,[16] and fragments of the second is in a Middle Turkish text, the *Khuastuanift*.[17] Al-Bīrūnī[18] saw a copy of the Manichaean gospel called 'The Gospel of the Seventy' which was attributed to Balāmis but says it was obviously a forgery.

[1] Kraeling, (4); Reitzenstein, (5), 162; *Islam*, 1923, xiii, 326.
[2] Wesendonk, (1); Weinreich, *A. Rel.*, 1925, xxiii, 90.
[3] F. C. Baur, (2); Bousset, PW, vii, 1507; Lentz, *Isis*, 1930, xv, 397; E. Meyer, (2), ii, 352; Otto, (1), 52; Reitzenstein, (5), 93, 162, 203 f.; Schaeder, (2), 71, 93.
[4] Schaeder, (2), 97 f., 156.
[5] Cumont, (1), 220; Kessler, (3); Scheftelowitz, (1), 8, 17, 79; Wetter, 116, 120.
[6] Bevan, ERE, viii, 394, 400; Schaeder, (2), 120.
[7] Alfaric, ii, 211 (denies); F. C. Baur, *loc. cit.*; Burkitt, (3), 44, 97 f.; *id.*, in C. W. Mitchell, (1), II, cxlii; Deussen, (1), II, ii, 314; C. W. King, (2), 42; Obolensky, *Chamb. Ency.*, ix, 61; Reitzenstein, (5), 93, 203; Schaeder, (2), 86 f. (not on Mānī himself); Scheftelowitz, (1), 40; Stokes, DCB, iii, 795.
[8] Harnack (with Conybeare), EB[11], 1911, xvii, 572–8.
[9] Cumont, (1), 142; (3), 219; Gasquet, 122; Legge, (1), ii, 277, 290; Wesendonk, (1), 212.
[10] Brandt, ERE, viii, 380; Chwolsohn, i, 129; Kessler, (3), 193 f., 199; Scheftelowitz, (1), 17 f., 79; Spiegel, (1), ii, 203; Tondelli, 82, 86 f., 97, 115 f.; Wetter, 107, 109, 116, 126; cf. Loisy, (1), 93 f.; Reitzenstein, (5), 154, 173; (12), 87, 265 f., 352, 384 f.; Schaeder, (2).
[11] Andreas, *Sitzb. Akad. Berlin phil.-hist. Kl.*, 1932–3, 175; C. Huart, *La Perse Antique et la Civilisation Iranienne*, 1925, 219; A. V. W. Jackson, (2); von Lecoq, *Abhl. Preuss. Akad., phil.-hist. Kl.*, 1922, No. 2; *id.*, *Auf Hellas Spuren in Ostturkestan*, Leipzig, 1926; *id.*, *Von Land und Leuten in Ostturkestan*, Leipzig, 1928; *id.*, *Buried Treasures of Chinese Turkestan*, 1928; Puech, (1), 27.
[12] Wesendonk, (1), 115.
[13] Alfaric, i, 27 f., 83 f., 87, 129 f., 137; Burkitt, (3), 7, 15, 48, 94, 119 f.
[14] Reitzenstein, (4), 1927, 275; Stokes, DCB, iii, 793.
[15] (1), 191–2.
[16] Chavannes and Pelliot, *J. Asiat.*, 1911, xviii, 499.
[17] Bang, *Muséon* (Louvain), 1923, xxxvi, 137–242 (text); Von Le Coq, JRAS, 1911, i, 277; Reitzenstein, (5), 152.
[18] (1), 27.

Some Manichaean fragments were found in Egypt[1] where a knowledge of Manichaeism probably appeared about A.D. 244 or later (Plotinos did not know of it).[2] In 1930 a small library on papyrus, including some writings of Mānī, was found in a jar in the Fayyūm.[3] They include the *Kephalaia*,[4] the title of which is given as the *Book of Chapters* (κεφαλαίων βίβλιον) in older authors; another is a *Book about Giants* (τῶν γιγάντων πραγματεία).[5] The chief work, *The Mysteries*, mentioned by Epiphanios, is known from a table of contents[6] and excerpts in al-Bīrūnī;[7] it dealt with Bardesanes, the planets, etc. The language of the original Manichaean texts was a dialect of Aramaic, related to Syriac; six of Mānī's seven main works were composed in it,[8] one (the *Shaburqān* or *Shāhpuhrkān*), in Pahlavī is mentioned by al-Bīrūnī.[9]

Before the discovery of the new texts there were two main sources of information: (i) Western, represented by the *Acts of Archelaios*, and (ii) Eastern in Syriac, Persian and Arabic, which give a different story.[10] The *Acta Archelai* attributed to Hegemonios, bishop of Kaskhar, but recognised by Beausobre[11] as pseudepigraphic, was in Greek, but only fragments of the Greek text and a complete Latin translation made in Rome about A.D. 400 are known.[12] The work, unknown to Eusebios (A.D. 326–30), is first quoted by Cyril of Alexandria (*c.* 348–50) and was used by Epiphanios (d. A.D. 403). It is anti-Manichaean, a disputation between Mānī and Archelaios. St. Ephraim (Ephrem Syrus) (d. A.D. 373) wrote a refutation of Manichaeism.[13] Mark the Deacon mentions a Manichaean mission to Gaza (*c.* A.D. 400) and gives a few fragments of the creed.[14] Epiphanios[15] gives a long account of Manichaeism, based on good sources. Excerpts (probably often quoting Mānī's actual words) are given by Theodore bar Kōnai, Nestorian bishop of Kaskhar in South Babylonia (*c.* A.D. 800) in his *Book of Scholia*.[16] A detailed account is in the Arabic *Fihrist* of al-Nadīm (A.D. 987)[17] and al-Bīrūnī (A.D.

[1] W. E. Crum, JRAS, 1919, 207 (Coptic fragment); D. S. Margoliouth, *J. Egypt. Archaeol.*, 1915, ii, 214 (Syriac fragm. in Oxyrhynchus papyrus).

[2] Puech, (1), 134.

[3] C. Schmidt and H. J. Polotsky, *Sitzb. Akad. Berlin, phil.-hist. Kl.*, 1933, 4; Polotsky and Ibscher, Manichäische Homilien, *Chester Beatty Manichaean MSS.*, i, Stuttgart, 1934; C. R. C. Allberry, A Manichaean Psalm Book, *ib.*, ii, 1938; Puech, *Rev. de l'Hist. des Religions*, 1948, cxxxiv, 244; Puech and Doresse, *Compt. Rend. Acad. Inscr.*, 1948, 87.

[4] *Mani Kephalaia. Manichäische Handschriften der Staatlichen Museum*, ed. C. Schmidt, Berlin and Stuttgart, 1935 f.

[5] Fabricius, (1) (*b*), vii, 310; Stokes, DCB, iii, 794.

[6] Alfaric, ii, 17.

[7] Al-Bīrūnī, (2), i, 48, 54, 381; ii, 169; Schaeder, (2), 74.

[8] Alfaric, i, 47; Burkitt, (3), 94, 111 f.

[9] (1), 191.

[10] Stokes, DCB, iii, 793–4.

[11] (1), i, 9 f., 129 f., 144 f.

[12] *Hegemonius Acta Archelai*, ed. C. H. Beeson, GCS, 1906; Migne, PG, 1857, vii, 1263; tr. by Salmond, ANL, 1871, xx, 267–419; Alfaric, i, 55, 94, 112; ii, 1 f.; Burkitt, (3), 12 f.; Cowell, DCB, i, 152; Deussen, (1), II, ii, 313; Puech, (1), 22 f.; Stokes, DCB, iii, 792.

[13] C. W. Mitchell, (1).

[14] *The Life of Porphyry, Bishop of Gaza, by Mark the Deacon*, tr. G. F. Hill, Oxford, 1913; Burkitt, (3), 8 f.

[15] Panar. lxvi; (1), 617–709.

[16] Pognon, (1), ii, 181 f. (Syriac text and tr.); Reitzenstein, (7), 204, 239 f., 243 f., 264 f., 281, 342 f.; Schaeder, (2), 90; J. Thomas, 215.

[17] Ed. and tr. G. L. Flügel, Mani, seine Lehre und seine Schriften, Leipzig, 1862; Alfaric, i, pref., 111 f., 123 f., 128; Burkitt, (3), 14 f.; Reitzenstein, (5), 28–42; Stokes, DCB, iii, 794. The section was analysed by J. H. Hottinger, *Historia Orientalis*, 2 ed., Zürich, 1660, bk. i, c. 8, pp. 245–308 (De Religione Sabæorum, Nabatæorum, & veterum Arabum; used in MS. by Beausobre), tr. J. Hammer-Purgstall, *Jahrbücher der Literatur*, Vienna, 1840, xc, 1–29.

1000).[1] Al-Shahrastānī (A.D. 1125) makes Mānī depend on Markion and Bardesanes; al-Mas'ūdī (d. A.D. 957) said he was a disciple of Kerdon (al-Bīrūnī's Fārādūn).[2]

The Manichaeans had different orders: twelve 'apostles', bishops, deacons, missionaries, etc. The 'elect' or 'perfect' were forbidden to take life, even by plucking flowers or fruits. Their food was provided by the large class of *auditores* (to which St. Augustine belonged in A.D. 373–382). An elect said: 'I have neither reaped nor ground, nor pressed nor cast thee in the oven. All these things another has done for me and brought thee to me.' He then took the bread and said to the auditor: 'I have prayed for thee.'[3] All abstained from animal food and alcoholic drinks.[4] The auditores had to undergo metempsychosis but the elect went straight to heaven.[5] St. Augustine attributes to the Manichaeans obscene rites like those practised by Barbelognostics (see p. 259).[6] The Manichaeans were commanded to avoid incantations and magic,[7] although all older authors agree that they practised magic, which was a widespread and common feature of Eastern heresies of the 3–4 cents.[8]

Zoroaster

The religion of Mānī is a dualism, based on the older Persian religion founded by Zoroaster (Persian Zarathushtra). In this was a good power Ahura Mazda (Ōhrmadz) with six helpers, Amesha Spenta, was opposed by an evil principle Angra Mainyu (Ahriman) with six helpers (*Devas*), each charged with undoing the good deeds of his opposite number.[9]

Zoroaster's dates are uncertain.[10] Some[11] give 1000 B.C. The *Bundahishn* (7 cent. A.D.) says Zoroaster converted Vishtāspa (Hytaspes) '258 years before Alexander', when Zoroaster was aged 42, and he lived 77 years. If this refers to the start of Alexander's rule in Iran (330 B.C.) it gives Zoroaster's dates as 630–553 B.C.;[12] if it refers to the beginning of the Seleucid era (312 B.C.) it gives 570–500 B.C.[13] Zoroaster perhaps came from far N.E. Transoxania. Darius I and his immediate successors, the early Achaemenian kings, were perhaps true Zoroastrians, who opposed the Magian priests and polytheists described by Herodotos (*c.* 400 B.C.),[14] who knew nothing of Zoroaster.[15]

The collection of texts called the *Avesta* (the Injunction) comprises seven

[1] (1), 190 f.; Burkitt, (3), 15.
[2] Alfaric, i, 13, 21, 126; de Faye, (1), 143, 530; McLean, ERE, viii, 407.
[3] Epiphanios, *Panar.*, LXVI, 23; (1), i, 645.
[4] Puech, (1), 89; Stokes, DCB, iii, 797.
[5] Gressmann, (1), 171 f.
[6] Stokes, DCB, iii, 798.
[7] Burkitt, (3), 54, 61.
[8] Plessner, *Islam*, 1927, xvi, 105; Stokes, DCB, iii, 798.
[9] Bousset, (1), 376 f.; *id.*, *A. Rel.*, iv, 254 f.; Cumont, (1), 190; Deussen, (1), II, ii, 136 f.; E. Meyer, (1), iii, 123, 172; Wesendonk, (1), 88, 92.
[10] Bidez, (2), i, 3; Christensen, (1), 212 f.
[11] Dhalla, (3), 624; Gray, CAH, iv, 207; Gressmann, (1), 124; Jackson, CHI, i, 323; E. Meyer, (2), ii, 58; J. H. Moulton, (1), viii, 8, 78, 87, 103, 197, 204; Wesendonk, (1), 16.
[12] Christensen, (1), 215 (650–600 B.C.); Henning, in Champion, (1), 289; A. V. W. Jackson, (1), 150 f. (660–583 B.C.); Nyberg, (1), 33 f.
[13] Herzfeld, (1), i, 1–30; *id.*, *Iran in the Ancient East*, 1941; Hertel, (1). *Oracles* and an *Apocalypse* attributed to Hytaspes (the father of Darius I) were in circulation before A.D. 150: Bidez, (2), i, 215; ii, 359; W. Scott, (1), iv, 26.
[14] i, 131.
[15] Albright, 276; C. Clemen, *A. Rel.*, 1913, xvi, 101.

main parts of various dates, the oldest being the *Gāthās* and *Yasna*, containing hymns attributed to Zoroaster. Mānī said Zoroaster wrote nothing. The present texts are probably of the Sāsānid period (3–7 cents. A.D.); summaries prepared in the 9 cent. are extant. A tradition in the *Dīnkart* (*c.* A.D. 820) makes Shāpūr (A.D. 241–72) incorporate into the *Avesta* information on science, medicine, and law which was obtained from India and the Byzantine empire.[1] The early Iranian culture described in the *Avesta* resembles the Indian culture which is presented in the *Ṛgveda*, and both were probably transmitted by oral tradition. The Pahlavī version of the *Avesta*, made in the 3 cent. A.D., is called the *Zend*. Zoroastrianism gradually died out in Persia after the Arabic conquest in the 7 cent.; it is now practically confined to the Parsis in India, especially Bombay, who first migrated about A.D. 700.

The usual Greek name of Zarathushtra was Zoroastres (*Ζωροάστης*); the Syriac Zaradusht appears as Zarades (*Ζαράδης*).[2] He was known to Xanthos of Lydia (*c.* 450 B.C.),[3] and his teachings were known in Plato's time. He was sometimes regarded as a Chaldaean, Babylonian, or Assyrian, and the inventor of astrology.[4] Pythagoras is said to have visited Zaratas (Zoroaster) and learned from him that there are two causes of all things, Father (Light) and Mother (Dark).[5] The penetration of the old Iranian religion by Babylonian astrology probably began with the capture of Babylon by Cyrus (539 B.C.); Darius (521–485 B.C.) destroyed the temples,[6] and the Babylonian planetary gods became evil demons.[7]

ψ-Clement[8] and Epiphanios[9] identified Zoroaster with Ham, son of Noah, and Nimrod, inventors of magic and astrology. This identification is Jewish. Zoroaster was also identified with Seth, and he was called by Josephus the inventor of astronomy.[10] Irano-Chaldaean doctrines were actively propagated by Jews in Syria and Asia Minor (Lydia and Phrygia).[11] In the magic papyri (many composed by Jews, see p. 275) evil demons are propitiated by sacrifices, miracles are performed by their help, poisons are used, etc.[12] Great numbers of forged books attributed to Zoroaster were circulating in the Hellenistic period. Hermippos (3 cent. B.C.) reports that he wrote two million lines on theology, natural science, astrology, and magic.[13] The old Zoroastrian religion was opposed to magic,[14] which surprised the Greeks. Pliny,[15] who says

[1] Bidez, (2), ii, 138; Gershevitch, *Chamb. Ency.*, 1959, ii, 4.
[2] Bidez, (2), i, 36 f.
[3] Diogenes Laertios, procm. 2; Bidez, (2), ii, 7.
[4] Bousset, (1), 376.
[5] Hippolytos, *Refut.*, i, 2; (1), 12; cf. Bidez, (2), i, 33, 36; ii, 40; A. V. W. Jackson, (1), 231.
[6] Lenormant, (3), 226 f.; E. Meyer, (1), iii, 91; Peet, *J. Egy. Archaeol.*, 1928, xiv, 196; Weber, *Beih. a. O.*, iii, 106 f., puts profound astrological influence later, from about 380 B.C.
[7] Darmsteter, SBE, xxiii, 89; Gressmann, (2), 9 f.; E. Meyer, (1), iii, 132, 172; (2), ii, 83 f.
[8] *Homil.*, ix, 3–5 (ed. Dressel, 1853, 198); *Recog.*, iv, 27–9; Bidez, (2), ii, 50 f.; Bousset, (1), 144, 369.
[9] *Panar.*, iv; (1), i, 4 f.
[10] Bidez, (2), i, 17, 30 f., 42, 45 f., 55, 84 f.; Bouché Leclercq, (1), 578; Bousset, (1), 376–8.
[11] Cumont, (1), 189 f., 279 f.; Dill, (1), 588; Horace, *Epodes*, v, 21 (Iberia); Hubert, DS, III, ii, 1499 f.; Juvenal, *Sat.*, vi, 548 f.; Vergil, *Bucol.*, 8.
[12] Cumont, (1), 190, 280; Darmesteter, SBE, iv, 26, 75 f.; Lucan (1 cent. A.D.), *Pharsalia*, vi, 520; Maspero, (2), 696; Minucius Felix (2–3 cent. A.D.), *Octav.*, 26; Plutarch, *Isis and Osiris*, 46.
[13] Pliny, xxx, 2; Bidez, (2), i, 85.
[14] Albright, 276; Bidez, (2), i, 143 f.; Carnoy, ERE, viii, 293; Gressmann, (1), 124, 138, 146; Reitzenstein, (4), 1927, 155.
[15] xxx, 2.

Zoroaster, perhaps a second one, was regarded as the originator of magic, implies that he wrote nothing, but large numbers of books attributed to him were circulating in the Alexandrian period.[1] Porphyry (3 cent.) showed that they were forged.[2] Zoroaster is mentioned by the alchemist Zosimos (A.D. 250–300).[3] Proklos (5 cent.)[4] quotes from four books on nature (*Περὶ φύσεως*) of Zoroaster, 'son of Harmonios the Pamphilian', on astrology, known to Clement of Alexandria (2 cent.).[5] Souidas[6] mentions a book on gems (*Περὶ λίθων τιμίων*), used by Pliny,[7] and also five books on astrology (*'Αποτελεσματικά*). The Turfan texts include fragments of Hellenistic lapidaries.[8]

In later Zoroastrianism the existence of evil was explained by introducing a neutral highest supreme god, Zurvān, over the opposing principles of Ahura Mazda (good) and Ahriman (evil); the idea also appears in some gnostic systems, in Mandaeism (see p. 314), and in some Indian speculations. It combined Iranian and Greek elements and was an approach to monotheism. The doctrine was held in higher circles in the Sāsānid period (from A.D. 274) but was pronounced heterodox by Chosroes I (A.D. 531–79) and dualism reinstated.[9] Zurvān akerana, who was the god of Unending Time, was identified with the Orphic god Ageless Time, *Αἰών ἄπειρος*.[10] Some accounts say that Zurvān first made two fundamental principles (*ἀρχαι*), fire and water, from which Ahura Mazda and Ahriman were made, Ahriman being a mixture of three, or four, elements.[11]

In later Zoroastrianism and Orphicism, and in Pherekydes, the first principle is Time; in Hesiod it is Space (chaos),[12] and in addition to Zurvān, Mithraists and gnostic in the Roman period had a god Place (*Τόπος*).[13] Zurvān is mentioned in the *Bundahishn*, in a Manichaean text from Turfan, by the Syrian bishop Theodore of Mopsuestia (4 cent. A.D.) and by the Armenians Eznik, Elisaeus, and Moses of Khoren, all in the 5 cent. A.D.[14]

Manichaeism

Mānī taught that there are and always have been two eternal sources or 'roots', Light and Dark, which were mixed together to form the visible world, as fire is a mixture of flame and smoke. They were originally separate in two domains but became mixed when the Ruler of the Dark came up to invade the realms of Light. The Ruler of Light was unprepared and was defeated, but he invoked the Mother of Light, who then evoked the First Man (not Adam but more like the gnostic First Man, *πρῶτος ἄνθρωπος*), not by birth but by 'calling' him. Dark is not merely the negation of Light but

[1] Bidez, (2), i, 85–163; ii, 7–261 (118 fragments).
[2] Bidez, (2), i, 154; ii, 249.
[3] Berthelot, (2), ii, 229.
[4] *Comment. on Plato's Republic*, ed. Kroll, 1901, ii, 34, 59, 109; Bidez, (2), i, 106; ii, 158 f.
[5] *Strom.*, v, 14; Migne, PG, ix, 158.
[6] (2), i, 740.
[7] xxxvii, Elenchos.
[8] Plessner, *Islam*, 1927, xvi, 105.
[9] Kaerst, ii, 239; E. Meyer, (1), 1937, iii, 123 f.; *id.*, (2), ii, 83 f.; Pallis, (1), 70; Reitzenstein, (5), 151, 159 f.; Scheftelowitz, (2) (Indian).
[10] Albright, 276; Eisler, (1), 475; E. Meyer, (2), ii, 84; Reitzenstein, (5), 177 f.
[11] Bousset, (1), 143; Deubner, Ro., iii, 2091; Pallis, (1), 74, 93.
[12] Meyer, (2), ii, 74.
[13] W. Scott, (1), ii, 90.
[14] Christensen, (1), 285; C. Huart, *La Perse Antique*, 1925, 211; E. Meyer, (2), ii, 84; Zaeher, (1), (2).

an actual evil substance; Greek writers e.g. Epiphanios[1] call it Matter, ὕλη. The object of the Manichaeans was to separate the particles of Light and Dark.[2] The two principles were conceived as dynamic forces acting in opposite directions (up and down, North and South, East and West).[3] Mānī's ideas of matter (ὕλη) are vague and contradictory; he himself does not seem to have identified Light with spirit (πνεῦμα) and Dark with matter (ὕλη).[4]

The universe of Light is unlimited above and at the sides, but limited below by the world of Dark, which is unlimited below and at the sides. Both contain five elements, fire, wind, water, light, and dark, sometimes superimposed, with God at the top; sometimes four elements are arranged in a square, with God and Dark above and below at opposite points making an octahedron.[5] Mānī recognised five hypostases of God: intelligence (νοῦς), science (ἔννοια), thought (φρόνησις), reflexion (ἐνθύμησις), and sentiment (λογισμός).[6]

The First Man was clothed in, or armed with, the Five Bright (or Pure) Elements, perhaps those of a higher world,[7] which are called in Syriac Zīwānē, in Turkish 'Five-God'. They are usually given as (1) light, (2) refreshing wind, (3) living fire, (4) limpid water, and a fifth, the nature of which is uncertain; pure air, ὕλη, gentle breeze, and ether have been suggested.[8] In the *Acta Archelai* the five 'limbs' of the Light Region are two kinds of fire (μέγα πῦρ or pure ether, and ἔσωθεν πῦρ ζῶον or good fire), wind (ἄνεμος), light (ἀήρ, not φῶς, in the *Acta Archelai*), and water.[9] Philastrius[10] says the Manichaeans worshipped the elements. Schaeder[11] said Mānī understood the elements in the Greek sense, each having two opposite qualities, and his fifth element was ether. After death, the body returns to the four elements fire, water, air, and earth.[12] In Al-Shahrastānī and Theodore bar Kōnai the five elements are four bodies and one spirit;[13] in the *Khuastuanift* they are breath, wind, light, water, and fire which represent the 'clothing' of Azrua (perhaps Zurvān or Aion), enclosing all space; in the *Fihrist* breath is the coat, light the cloak, water the shield, fire the lance.[14] Corresponding with the five elements, the *Khuastuanift* has five kinds of animals: plants, trees, attributes, tastes, planets and their rulers (archons), and metals (gold, copper, iron, silver, and

[1] *Panar.*, lxvi, 25; (1), i, 642.
[2] Alfaric, i, 1 f., 32 f., 50; ii, 15 f., 21 f., 33, 44, 61, 66, 126; Bousset, (1), 166, 348; Buonaiuti, 97; Burkitt, (3), 4 f., 17 f., 20 f., 64, 95, 100; de Faye, 21; Kessler, (3), 205; Reitzenstein, (5), 94; Schaeder, (2), 86; Wesendonk, (1), 118; Epiphanios, *Panar.*, lxvi, 66; ed. Petav., i, 680, implies that the visible world was created by the powers of the Dark, but says the accounts are contradictory.
[3] Puech, (1), 75.
[4] Bevan, ERE, viii, 397; Bousset, (1), 134; Stokes, DCB, iii, 796.
[5] Burkitt, in C. W. Mitchell, (1), II, cxxxi; Loisy, 93.
[6] Bousset, (1), 235.
[7] Alfaric, ii, 64; Scheftelowitz, 43; Stokes, DCB, iii, 796.
[8] Burkitt, (3), 4, 17, 20, 24, 29, 33 f., 50–8, 107; Puech, (1), 77.
[9] Bousset, (1). 134, 143, 231 f.; Reitzenstein, (13), 249.
[10] *De Haeres.*, 61; Migne, PL, xii, 1176.
[11] (2), 126.
[12] Spiegel, (1), ii, 228.
[13] Alfaric, i, 34; Burkitt, (3), 109; Pognon, (1), ii, 184.
[14] Reitzenstein (4), 225; (5), 8, 41, 64 f., 162, 249.

tin, lead was a kind of tin).[1] Reitzenstein derived the five elements from the old Hindu (soon after the Brāhmana period): fire, water, earth, wind, and *akasa* (empty space, or ether), and ultimately from the Chinese five elements: fire, water, earth, metal, and wood.[2]

The five Dark Elements are darkness or obscurity, air or violent wind, devouring fire, turbid water or mud, and smoke or mist.[3] The brilliant and pure parts of gold and other metals are composed of light, the dull and impure parts of dark.[4]

There are elaborate accounts of the struggle between the powers of Light and Dark, in the course of which five archons (rulers of the planets) appear and swallow the particles of light, and plants and animals were formed.[5] The particles of light were extracted by a Third Creation or Messenger (Īzgaddā,) playing the part of the gnostic female Barbelo (see p. 323), who tempted the Archons and caused them to emit their power.[6] The Virgin of Light (παρθένος τοῦ φωτός) in the *Acta Archelai*, perhaps not identical with the Third Creation) is more important in the Turfan texts.[7] The Mother of Life (μήτηρ τῆς ζωῆς) or Mother of All (μήτηρ τῶν ὅλων), corresponding with the gnostic Sophia, is said to be the daughter of Zurvān and Androgyne; the Mandaeans say she resides in the moon.[8]

Jesus invented a machine (the zodiac?) composed of a chain of twelve buckets which drew the light from the kingdom of darkness and discharged it into the Moon, which passed it to the boat of the Sun for transmission to the celestial regions.[9] It has been described as a 'vast distillation apparatus' for separating light from darkness[10] and the fundamental power of salvation was a separation of the soul from matter. The rest of the dark substance from which all the light has been extracted will be gathered into a Clod (βῶλος, the name is retained in the Syriac), which is imprisoned in a pit covered with an immense stone.[11] There are two cosmic trees, of Life and Death, corresponding with Light and Dark.[12] The theory of the Fall of Man is Ophite (see p. 256): the Powers of the Dark prohibited man from partaking of the Tree of Knowledge but Christ, the Spirit of the Sun, appeared in the form of a serpent and

[1] Alfaric, i, 31 f., 41; Burkitt, (3), 19, 59; Polotsky, PW, Suppl. vi, 250; Puech, (1), 75 Reitzenstein, (7), 253; for such pentads see Junker, *Vortr. Bibliothek Warburg*, 1927, 160; there are similar Chinese comparisons.

[2] Reitzenstein, (5), 162, 204; (7), 279; Schaeder, (1). The Chinese five elements are not as old as Reitzenstein thought.

[3] Alfaric, i, 34; Burkitt, 25; Kessler, (3), 206; Pognon, (1), ii, 184; Puech, (1), 75. Rain is the perspiration of demons, Bevan, ERE, viii, 397.

[4] Spiegel, (1), ii, 214.

[5] Alfaric, i, 31 f.; Bousset, (1), 75, 134, 143, 334; Burkitt, (3), 26 f., 100 f.; Puech, 78 f.; Reitzenstein, (5), 79; Scheftelowitz, (1), 57.

[6] Alfric, i, 38–43; Bousset, (1), 75, 334; Burkitt, (1), 29 f., 103; Polotsky, PW, Suppl. vi, 240.

[7] Bousset, (1), 76; Lipsius, DCB, iv, 716.

[8] Reitzenstein, (5), 174, 178, 204, 215; Scheftelowitz, (1), 8 f. (Ishtar).

[9] Epiphanios, *Panar.*, lxvi, 26; (1), i, 643 (12 κάδους); Alfaric, i, 36, 39; ii, 24, 46, 50; Boll-Bezold-Gundel, Sternglaube und Sterndeutung, 1931, 77; Bouché Leclercq, 608–9, 625; Burkitt, 43 f., 49, 52; Cumont, *Rev. de l'Hist. Rel.*, 1915, lxxii, 384; Loisy, 95; Puech, 79, 83, 176; Reitzenstein, 1921, 36, 201.

[10] Schaeder, (2), 81 (Leisegang disagreed).

[11] Alfaric, i, 45–6; ii, 25; Burkitt, 65 f.; Puech, 84, 178; Tondelli, 91, 139, 147 f.

[12] Alfaric, ii, 27; Brandt, (1), 116, 196; Burkitt, (3), 18; Evola, 9.

counteracted this command. The Manichaean teaching on the Incarnation is docetic.[1]

A Turfan text says the Manichaeans worshipped the seven planets, and admitted seven corresponding elements in man.[2] A Turfan text, and the *Fihrist*, explain how the ascent of the soul is impeded by the seven rulers of the planets, who appear as black demons in grey clouds and black smoke, but the soul is guided past them.[3] The accounts are very contradictory. Sometimes the sun, moon, and stars are good powers, as in old Iranian beliefs,[4] sometimes the fixed stars are demons.[5] The names of the planets are Babylonian.[6] Orthodox Zoroastrians did not and do not believe in astrology.[7] The Manichaeans had a planetary week and paid much attention to numbers: the 4 seasons, the 12 signs of the zodiac, 10 heavens, 8 earths, 6 steps each with 30 grades, etc.[8] These may be derived from the Egyptian magic papyri.[9]

The Three Times (in a Chinese text) are (i) the past, when Light and Dark were separate, (ii) the present, in which they are mixed and man, and (iii) the future, which will achieve the absolute separation of Light and Dark. The end of the world, which will be announced by the appearance of the Ancient One, will be a great conflagration in which the remaining particles of light will be separated as by distillation.[10]

Manichaeism was prohibited in the Roman Empire in A.D. 287 by Diocletian. Christian authors condemned it from the 3 cent. It was expounded in secret until it disappeared from the west, in the 6 cent. but persisted in Byzantium till the 9 cent.[11] It was spread by missionaries to all parts.[12] It was especially active in Asia Minor and 'Irāq.[13] Manichaean texts, with works of Markion and Bardesanes, were translated from Persian into Arabic in the time of the 'Abbasids, especially al-Mahdi (A.D. 775–85), and in al-Nadīm's time (A.D. 987) there was an abundant literature.[14] It was professed by the Barmakids (originally from Balkh) and the Persian elements, but was harshly treated by the orthodox Muslims.[15] It appeared in China in A.D. 694, and about A.D. 762 became the official religion of the Turkish Uyghurs, with their capital in Turfan, from the Yellow River to the mountains of Tibet.[16] It vanished from Islam in the 11 cent. and from China about A.D. 1200.[17] It penetrated even to Scandinavia.[18] The Paulicians, originating in Armenia

[1] Stokes, DCB, iii, 796.
[2] Alfaric, ii, 15.
[3] Reitzenstein, (5), 29 f., 32.
[4] *Ib.*, 64.
[5] Alfaric, i, 36.
[6] Scheftelowitz, (1), 8 f.
[7] *Ib.*, 32 f., 48.
[8] Alfaric, i, 35, 37; Spiegel, (1), ii, 216.
[9] Boll, *T'oung Pao*, 1912, xiii, 699; Reitzenstein, (5), 147 f., 153 f., 172 f.
[10] Bousset, (1), 230; Kessler, (3), 210; Spiegel, (1), ii, 230.
[11] Alfaric, i, 55 f., 92–100.
[12] Alfaric, i, 55 f.; E. de Stoop, Essai sur la Diffusion du Manichéisme dans l'Empire Romain, *Rec. Trav. Univ. Gand*, 1909, xxxviii.
[13] Alfaric, i, 66–71.
[14] *Ib.*, i, 75, 123.
[15] Alfaric, i, 79; Kremer, ii, 169.
[16] Alfaric, i, 82–4; Puech, (1), 64 f.
[17] Alfaric, i, 105–8.
[18] Reitzenstein, (7), 49, 217, 352.

about A.D. 650, persisted beyond the 11 cent.[1] and influenced various heretical sects in Europe till the 15 cent.[2] Manichaeism is now extinct, except among the Yezids of the Caucasus, Armenia, and Kurdistan.

[1] Photios, *Contra Manichaeos*, Migne, PG, 1860, cii, 10–263; Petrus Siculus, *ib.*, 1860, civ 1231 f.
[2] Wesendonk, (1), 116.

CHAPTER XIX

THE ḤARRĀNIANS (ṢĀBIANS)

The people of the ancient city of Ḥarrān in N.W. Mesopotamia, later called Ṣābians, continued, well into the period of Islām, the ancient paganism and star worship of Babylonia. They were the reputed pupils of Hermes and Agathodaimon of Egypt, and were also acquainted with Greek Neoplatonism and gnosticism. The Ummayyad khālif Marwān II (A.D. 744–50) transferred his residence to Ḥarrān and was defeated near there by the 'Abbāsid army in A.D. 750. Ḥarrān was also the place of defeat of Crassus by the Parthians in A.D. 53.[1]

Ḥarrān (*Κάρραι*, Carrhae), three miles from Edessa, now near Urfa in Turkey, was important at least as early as 1400 B.C. as a centre of trade and a meeting place of caravans from east and west.[2] It had an ancient temple of the Babylonian moon-god Sin, represented as a crescent on a conical pillar, and worshipped through Roman, Christian, and Arabic periods as Selene or Deus Lunus; the temple contained ancient relics.[3] It is now in ruins. Recent excavations disclosed remains dated 2500 B.C. According to legend[4] Selene was buried in Ḥarrān, Kronos in the Caucasus, Zeus in Crete, Helios at Atir (in Mesopotamia), Ares (Mars) in Thrace, Aphrodite (Venus) in Cyprus, Asklepios in Epidauros, Hermes (a man) at Hermopolis in Egypt, Poseidon (Neptune) in Acharusia, Dionysos in Thebes, Bēl in Babylon,[5] Plato in Alexandria, Aleppo, or Iconium,[6] and Aristotle in Palermo.[7]

Accounts of the Ḥarrānians (usually called Ṣābians) are given by many Muslim authors,[8] e.g. Abū Sa'īd Waḥab ibn Ibrāhīm, a Christian, used by al-Nadīm; Th'ābit ibn Qurrah (826/7 (or 835/6)–901), al-Kindī (d. *c.* 873), ibn Khurdādhbih (d. *c.* 912), Ibn al-Waḥshīya (*c.* 905), al-Rāzī (865/6–925),[9] Ṭabarī (A.D. 922), using authors going back to A.D. 770,[10] Ibn Ḥawqal (d. 977),[11]

[1] Carra de Vaux, *Ency. Islam*, iv, 21 (al-Ṣābi'a); Chwolsohn; al-Dimashqī, (1); Dozy, (3); Hitti, 1961, 309, 358; S. Lane Poole, (1), 252 f.; Maqrīzī, (1); D. S. Margoliouth, ERE, iv, 519–20 (Ḥarrānians); Masūdī, (1), i, 73, 198; 1863, ii, 111–12; 1864, iii, 348; 1865, iv, 61–9; *id.*, in Carra de Vaux, (4); Reitzenstein, (2), 165 f., 365; W. Scott, (1), i, 97–111; J. Thomas, 197 f.; Thorndike, (1), i, 661; T. H. Weir, *Ency. Islam*, ii, 270 (Ḥarrān).

[2] Chwolsohn, i, 15, 301 f., 448; F. Hommel, in H. V. Hilprecht, *Exploration in Bible Lands*, Edinburgh, 1903, 734; Mez, (2); E. Schrader, *Die Keilinschriften und das Alte Testament* 3, 1903, 29; F. Spiegel, (1), i, 293; T. H. Weir, *Ency. Islam*, ii, 270; Weissbach, PW, x, 2009.

[3] Chwolsohn, i, 170, 206, 395, 399, 412; ii, 156, 183; Mez, (2), 9, 27.

[4] ψ-Clement, *Homil.*, v, 23; vi, 21; ed. Dressel, 1853, 150, 170; ANL tr., 126.

[5] Chwolsohn, i, 400; Zimmern, *Alte Orient*, 1925, xxv, Heft 3, 16.

[6] Dimashqē, (1), 318.

[7] Ibn Ḥawqal; W. Hertz, (1), 403.

[8] Chwolsohn, i, 181–282, 196, 203, 250, 542 f., 679 f.; II, i–xxxii.

[9] Mas'ūdī, (1), iv, 68; Chwolsohn, i, 201; II, xiv, 373.

[10] Margoliouth, ERE, vi, 519–20; unknown to Chwolsohn.

[11] Abū'l Fida; Reinaud, (2), II, ii, 53.

al-Iṣṭakhrī (*c.* 950), who mentions the temple at Ḥarrān, with 17 servitors,[1] al-Mas'ūdī (d. *c.* 957, who was in Ḥarrān *c.* 943), al-Nadīm, author of the *Fihrist* (987/8), al-Bīrūnī (973–1048), Muṭahhar ibn Ṭāhir al-Maqdisī (or Muqaddasī) of Jerusalem (*c.* A.D. 996),[2] al-Shahrastānī (1076/7–1153), al-Qifṭī (1172/3–1248), ibn Sa'īd al-Maghribī (fl. *c.* 1250), Abū'l-Faraj (Bar Hebraeus) (1226–86), al-Dimashqī (1256/7–1326/7), and Maqrīzī (d. 1441). Ḥarrān was built in the shape of a half-moon.[3] Ezekiel (6 cent. B.C.)[4] names it among the 'Merchants of Tyre'; Abraham in Jewish and Arabic traditions[5] was connected with Ḥarrān (his father Terah died there), and in the *Book of Jubilees* (100 B.C.–A.D. 100) Abraham is said to have worshipped the stars.[6] Yāqūt (A.D. 1179–1229) says it was the first town built after the Flood,[7] and Ibn Ḥawqal (*c.* A.D. 977) that the temple on a hill was built by Abraham.[8] Since the moon was always male for the Semites and the Greek Selene was female, Deus Lunus was epicene.[9] Muslim authors relate the name Ḥarrān to those of the father (Terah) or brother (Ḥārān) of Abraham, and say that its religion is the oldest in the world,[10] but al-Dimashqī[11] said many stories told by the Ḥarrānians were lies.

The Ḥarrānians were a pocket of Syrian heathens who obstinately retained their old Babylonian religion, modified by Persian influences, as it existed in the late Babylonian (Chaldaean) empire, particularly star worship, although since Alexander's time they were under Greek influence and some of the population were perhaps Greek or Macedonian.[12] Greek was a popular language from Alexander's time and until the 9–10 cent. A.D. was still well known; they were then practically the only preservers of Greek science, Hellenistic literature, and philosophy,[13] particularly Neoplatonism,[14] Hermetism, and Gnosticism.[15] Damaskios, one of the Athenian philosophers who left the court of Chosroes in A.D. 533 (see p. 235), apparently did not return to Athens and may have stayed in Syria, perhaps Ḥarrān,[16] and made Neoplatonism known there. Some of the Ḥarrānian gods had Babylonian names, and their temples and ritual probably followed Babylonian practice. Thus they

[1] Chwolsohn, i, 215; ii, 546.
[2] *Kitāb al-bad' wa'l-tārīkh*; ed. and tr. C. Huart, *Le Livre de la Création et de l'Histoire* (attributed to Abū Zaid Aḥmad ibn Sahl al-Balkhī), 6 vols., Paris, 1899–1919; *id.*, *J. Asiat.*, 1901, xviii, 16.
[3] Al-Bīrūnī, (1), 186 f., 314 f.; Chwolsohn, i, 15, 20, 311, 449, 472, 813; S. Lane Poole, (1), 259.
[4] xxvii, 23; Chwolsohn, i, 334, 342.
[5] *Gen.*, xi–xiv; *Acts*, vii, 4; Carra de Vaux, (3), 131.
[6] Kautsch, ii, 62.
[7] Weissbach, PW, x, 2009.
[8] Abū'l-Fidā'; Reinaud, (2), II, ii, 53.
[9] Chwolsohn, i, 206; Jeremias, Ro., iv, 889 (Sin); E. Meyer, (2), iii, 291; Plutarch, *Isis and Osiris*, 43 (the moon was epicene for the Egyptians); Spartianus, *Caracalla*, 4 (*Scriptores Historiae Augustae*, ed. Hohl, Leipzig, 1927, i, 191 (Lunus).
[10] Chwolsohn, i, 159, 254, 802; ii, 549.
[11] (1), 47, 259.
[12] Baudissin, *A. Rel.*, xiv, 417; Bousset, (1), 22; *id.*, *A. Rel.*, iv, 241; Carra de Vaux, (2), 61; Chwolsohn, i, 14, 141, 144, 159 f., 167, 172 f., 175, 180, 204, 348 f., 359 f.; O'Leary, (1), 43, 118; W. Scott, (1), i, 100.
[13] Chwolsohn, i, 14, 174, 254; ii, 650; Nicholson, JRAS, 1906, 318.
[14] Chwolsohn, i, 166, 546.
[15] Bousset, (1), 23 f.; Reitzenstein, (2), 166 f.
[16] Chwolsohn, i, 173; W. Scott, (1), i, 103–4; Stahr, DB, i, 932.

were very important transmitters of old traditions.[1] This type of mixed culture existed at least as early as the 3 cent. A.D.[2]

The Ḥarrānians were talented and adaptable, and some translated from Greek and Syriac into Arabic.[3] These included Th'ābit ibn Qurrah (see p. 330) and the astronomer al-Battānī (Albategnius) (858–929).[4] Many lived in Baghdād as astronomers, physicians, and secretaries to khālifs, and acquired great celebrity. This colony, most active about A.D. 892–902 under al-Mu'taḍid, could not have practised the Ṣābian religion since there could hardly have been a temple there.[5] Their study of medicine is mentioned by Ibn Abī Uṣaibi'a (1203/4–1270) who says they claimed that it originated among their priests and was practised in their temples.[6]

The sources of information on the Ḥarrānians are mostly those of their opponents, Christian or Muslim, who may have used works of doubtful authenticity, or have confused their beliefs with those of others. Ḥarrān was also a centre for the production of apocryphal, philosophical, religious, and magical-mystical books, ascribed to the 'prophets' Pythagoras, Plato, Aristotle, Hermes ('Prince of the Ḥarrānians'), and his great pupil (or teacher) Agathodaimon, Hermes Trismegistos (the 'King, Philosopher, Prophet, and Patron of the books'), Asklepios, the great magician Ostanes, and others.[7] The Arabs took a great interest in this literature, and themselves imitated it.[8]

Hamza Iṣfahānī (*c.* A.D. 961)[9] distinguished the eastern Ṣābians (Mandaeans) and the western of Ḥarrān (he calls them Chaldaeans). Al-Nadīm (A.D. 987/8) distinguished the two Babylonian (Mandaeans), and the Syrian Ṣābians (Ḥarrānians), although he thought both worshipped the stars,[10] whilst Mas'ūdī thought the latter were Egyptians.[11] Al-Bīrūnī (A.D. 1000)[12] also distinguished them; the Ḥarrānians followed the pre-Zoroastrian Persians in worshipping the planets and the elements, idols of which were in the temples, and they had festivals of the worship and marriage of the elements. He calls them 'Ḥarrānians' (al-Ḥarrāniyya), which is more correct than Ṣābians, the latter being a fictitious name. Abū Yūsuf Absha' al-Qaṭī' (a Christian living in Ḥarrān *c.* A.D. 900) says they assumed it about A.D. 830, when the Khālif al-Ma'mūn, passing through Ḥarrān, noticed the peculiar people, wearing long hair and tight coats, and questioned them on their religion. Not satisfied, he told them that if, on his return, they had not become Muslims he would exterminate them. They consulted a Muslim lawyer, who, for a large fee, advised them to tell the Khālif that they were the Ṣābians (Ṣābi'a, Ṣā'bī'ūn),

[1] Carra de Vaux, (2), 68; Chwolsohn, i, 166, 488; Dozy, (3), 291.
[2] Bousset, (1), 22; *A. Rel.*, iv, 241.
[3] Chwolsohn, i, 542–623 (some thirty names); L. Leclercq, i, 335.
[4] Carra de Vaux, (2), 70.
[5] Chwolsohn, i, 472 f., 489; Kremer, (1), 165, 171; W. Scott, (1), i, 103.
[6] Chwolsohn, i, 247; ii, 601.
[7] Bousset, (1), 22 f.; Chwolsohn, ii, 4; Dozy, (3), 292 f., 360; Reitzenstein, (2), 168.
[8] De Boer, (1), 16, 21 f.; Kroll, PW, vii, 832 (Hermes); Reitzenstein, (2), 166 f.
[9] *Hamzae Ispahanensis Annalium Libri X*, ed. and tr. I. M. E. Gottwaldt, 2 vols., St. Petersburg, 1844 (text) and Leipzig, 1848 (tr.), ii, 3, 21; Chwolsohn, i, 109, 142, 162, 216; ii, 546.
[10] Chwolsohn, i, 135, 220; II, vii, 1 f. (tr.).
[11] Bousset, (1), 24.
[12] (1), 186 f., 315.

mentioned in the *Qur'ān* and that they had a holy book. They did this and were tolerated.[1]

Abū'l Faraj gave the name Ṣābian to *all* heathen religions, Persian, Chaldaean, Greek, Egyptian, Turkish, Indian, and Chinese;[2] the last two are mentioned by several authors, and Mas'ūdī says the Ṣābian religion was founded by Būdāsp (Buddha), who lived in the times of the old Persian kings Thamūrath' or Jimshēd.[3] Ibrāhīm ibn Waṣīf-Shāh (before A.D. 1209) said the old Spaniards, Romans, and Persians were Ṣābians, the Persians burning a sacred fire of sulphur and arsenic.[4] There was also confusion with the Mandaeans.

Chwolsohn,[5] following earlier partly correct indications by Johann Heinrich Hottinger (1620–1667),[6] who used the *Fihrist*, and Richard Simon (1638–1712),[7] distinguished three groups of Ṣābians: (i) those mentioned three times in the *Qur'ān*; (ii) the Syrian heathen Ṣābians of Ḥarrān who disappeared as such in the 12 cent.; and (iii) fictitious Ṣābians of Arabic, Jewish, and Persian authors from the 10 cent., heathens generally, especially star-worshippers, including the ancient Egyptians and Babylonians, pre-Zoroastrian Persians, Indians (including Buddhists), Chinese, Neoplatonists, etc. These three groups were confused by European scholars such as Scaliger, Selden, Salmasius, Stanley, Pococke, Hyde, etc., who were misled by the account in Maimomides (A.D. 1135–1204), whose *Mōreh-han-Nebūkim* (Guide to the Perplexed), was printed about 1480, and aroused interest in the matter.[8] His chief source was a spurious *Nabataean Agriculture*, alleged to be an Arabic translation from old Babylonian sources but probably compiled by Ibn al-Waḥshīya (*c.* A.D. 904), which Chwolsohn[9] regarded as genuine. In Islam after *c.* A.D. 1000, Ṣābian meant almost any heathen sect.[10] Muḥammad's Ṣābians were the Elchasites or the Mandaeans (see p. 314),[11] and he also knew of the Persian Magian fire worshippers (Majūs), East Arabia and the Yaman having been under Persian domination in the 6 cent.

The Moon Temple at Ḥarrān is mentioned by Herodian (2 cent.) and Spartianus (4 cent.).[12] John of Antioch (a contemporary), and al-Ḥawamī, say it was destroyed in A.D. 1032;[13] al-Dimashqī gives two accounts, the first that

[1] Chwolsohn, i, 13, 139 f., 143, 148 f., 158, 456; ii, 16, 126 (Abū Yūsuf, in the *Fihrist*); O'Leary, (1), 173 (doubts the story, which is quite probable); Mez, (1), 35.

[2] Chwolsohn, i, 209, 254.

[3] Chwolsohn, i, 207.

[4] Carra de Vaux, (3), 116, 128; Chwolsohn, i, 237.

[5] *Thesaurus Philologicus seu Clavis Scripturae*, 4°, Zürich, 1649, 53–5; 2 ed., 1651, 54–9; *id.*, *Historia Orientalis*, 4°, Zürich, 1651, 102–203 (De Religione Sabæorum, Nabatæorum, &c. veterum Arabum).

[6] *Histoire Critique du Vieux Testament*, bk. i, ch. 7, bk. ii, ch. 4, bk. iii, ch. 6, and *Catalogue*, Paris, 1678; 4°, Rotterdam, 1685, 47–50, 211, 379, 545; *A Critical History of the Old Testament*, 4°, i, 55; ii, 35; iii, 33.

[7] Chwolsohn, i, 23 f.

[8] i, 199, 689 f., 697, 712, 821; ii, 450 f., 721, 910: 'revised at the end of the 9 cent. by a Chaldaean magician and alchemist.'

[9] Pedersen, *Islam*, 1923, xiii, 113; W. Scott, (1), i, 99.

[10] Alfaric, i, 3; E. G. Browne, (2), 1902, i, 302, 304; Chwolsohn, i, 13, 112, 129, 149; ii, 543, 806; Nöldeke, *A. Rel.*, x, 151; Scott, (1), i, 98.

[11] Carra de Vaux, (1), ii, 147; Chwolsohn, i, 399.

[12] Carra de Vaux, (1), ii, 147; Chwolsohn, i, 232, 666 f.

it was captured by the 'Alids (Fāṭimids) of Egypt in A.D. 1050, the other that it was completely destroyed by the Mongols (al-Maqrīzī says in A.D. 1230). After this, the Ḥarrānian Ṣābians vanished from history. They had decreased from A.D. 950 and in A.D. 1000 only forty were known.[1] In another account[2] the city was destroyed in A.D. 932–4, was rebuilt but destroyed again in 1032, only the Moon Temple remaining; Abū-'l-Fida in 1332 found only a decaying village on the site. Al-Jalīl al-Sijzī (*c.* A.D. 951–1024)[3] says the qāḍi al-Iṣṭakhai, the muḥtasib of Baghdād, in A.D. 933 demanded the extermination of the Ṣābians, who gradually became Muslims, their last chief official being Ḥukaym ibn 'Isā ibn Marwān, the successor of Sa'dān ibn Jābir (d. A.D. 944).[4]

The revolting accounts of human sacrifices, including children, in al-Nadīm[5] and al-Dimashqī,[6] it is thought, can hardly refer to the Ḥarrānians of their time, who were cultured, and human sacrifices would have been mentioned by Classical authors who were familiar with the people. They may have been Babylonian and al-Dimashqī's Ṣābians some other heathen nation.[7] But al-Nadīm and al-Dimashqī were careful authors using good sources on the Ḥarrānians, al-Dimashqī 'a man close to them'. It is quite likely that the old Ḥarrānians offered human sacrifices;[8] Theodoret says the Emperor Julian had one performed in the temple at Ḥarrān,[9] and al-Bīrūnī[10] says 'Abd-almasīḥ ibn Isḥāq Alkindī, the Christian, in his reply to the book of 'Abdallāh ibn 'Ismā'īl Alhāshimī, said the Ḥarrānians were notorious for human sacrifice, 'but at present they are not allowed to do it in public.' Human sacrifice was practised in ancient Egypt, Phoenicia, Rhodes, etc., as well as by the ancient Greeks and (to a smaller extent) by the old Romans;[11] it may have been practised openly by the ancient Ḥarrānians, and perhaps in secret (in the cellars of the temple) in Muslim times.[12] Mas'ūdī says children were taken into the temple cellar and terrified by speaking idols, operated by a hidden priest.[13] Al-Nadīm[14] and al-Dimashqī[15] give details of the preparation of an oracular human head, which was perhaps known to Mas'ūdī,[16] although he says that he will 'pass over in silence' the details. The 'prophetic heads' (*teraphim*) appear in 8-cent. Jewish Rabbinical literature, e.g. a sacrificed child's head with gilded lips is specified,[17] and in several other accounts.[18] The story was transferred to the Templars.[19] Al-Nadīm[20] and al-Dimashqī[21] say that as late as the time of Hānūm al-Rashīd (763–809) a man with the appearance

[1] Brockelmann, (2), 4; Chwolsohn, i, 18, 232, 496, 666 f., 810; Kremer, (1), ii, 165, 171; Mez, (1), 35.
[2] O'Leary, (1), 174–5.
[3] Sarton, (1), i, 665.
[4] Massignon in Festugière, (1), i, 385–6, 400 ('Siljazi').
[5] Chwolsohn, ii, 28, 84, 142 f.
[6] *Ib.*, ii, 387 ff. (in gruesome detail), 647 (sources).
[7] Chwolsohn, ii, 647 f., 653, 913; W. Scott, (1), i, 100.
[8] Dozy, (3), 293; Frazer, *The Golden Bough*, 1923, 444.
[9] Chwolsohn, i, 426; Wordsworth, DCB, iii, 514.
[10] (1), 187.
[11] Horace, *Epod.*, v.
[12] Chwolsohn, ii, 142 f.
[13] Chwolsohn, ii, 370.
[14] Chwolsohn, ii, 19 f., 154 f.
[15] *Ib.*, ii, 388 f.
[16] (1), iv, 62; Chwolsohn, ii, 368, 648 f.
[17] Chwolsohn, i, 465; ii, 150 f.
[18] al-Dimashqī, (1), 43; Dozy, (3), 266; Ibn Khaldūn, (1), i, 225.
[19] Hammer-Purgstall, Mysterium Baphometis Revelatum, in *Fundgruben des Orients*, Vienna, 1818, vi, 1–125, and plates; he thought it was of Ophite gnostic origin.
[20] Chwolsohn, ii, 15 f.
[21] *Ib.*, ii, 389.

of Mercury (in al-Dimashqī the sacrifice is to Mars) was put alive in a jar of oil and soda (or borax) for a year, till the limbs soften, when the head was pulled off. The spirit of Mercury entered it, making it prophetic, and it was worshipped, answering questions. 'What they do with the other parts of the body also is described in the Book *al-Hātifī* which contains wonderful things on natural magic, magic knots, figures, parts and pictures of animals, fumigation, ring stones, and figures to be engraved on gems.' Al-Nadūn had seen this book[1] which seems to have been like the *Book of Ṭumṭum* the Indian, quoted by Maimonides and Ḥājjī Khalīfa, containing pictures of the spheres and planets, and one by Yaḥyā ibn Abū Bakr, a friend of Jābir ibn Ḥayyān.[2] It is possible that the 'talking head' was that of an idol, the priest behind speaking through a tube. The 'preparation of the head' was afterwards some kind of alchemical operation.[3] Al-Nadīm had seen many of the engraved seals and Ṣābians in Baghdād told him they had been found in old graves, burial with a corpse greatly increasing their virtue.[4]

The Ṣābian temples were 3-, 4-, 6-, and 8-sided (perhaps by added rectangular parts).[5] Maqrīzī said there were five circular (perhaps hemispherical) temples, viz. of the first cause (with 48 windows), the first intelligence (without windows), government, exterior form, and soul; the shapes of the planetary temples and the days of worship being:[6]

SATURN	JUPITER	MARS	SUN	VENUS	MERCURY	MOON
hexagon	triangle	square	square	elongated triangle	rectangle in triangle	octagon
Saturday	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday

Shape-symbolism is also found in Hindu temples, also colours.[7] Maqrīzī put the temples in various places; the first to be erected was the Ka'bah in Makkah, dedicated to Saturn, pilgrimage to which was instituted by Hermes the ancient, Trismegistos or Idrīs; the second, of Mars, was at Tyre; the third, of Jupiter, at Damascus; the fourth, of the Sun, at Heliopolis ('Aīn-Shams) in Egypt; the fifth, of Venus, at Mambij (Hieropolis); the sixth, of Mercury, at Ṣaidā (Sidon); and the seventh of the Moon, at Ḥarrān, of which it was the citadel.[8] At least in later times, Ḥarrān had only one temple (of the Moon), or perhaps two;[9] the others mentioned were perhaps various heathen temples regarded as Ṣābian (Chwolsohn's third group), in pre-Islamic Makkah, Iṣfahān, Balkh, Farghānah, India, and perhaps China. Probably in Muslim times the idols were kept out of sight in cellars.[10] There were also pictures (of

[1] Chwolsohn, ii, 21, 138, 141.
[2] Chwolsohn, i, 712 f.; ii, 21, 138–9, 461, 480; Ruska, (2), ii, 29, 32.
[3] Dozy, (3), 295; Mas'ūdī, (1), iv, 63.
[4] Chwolsohn, ii, 21, 142; Thorndike, (1), i, 662.
[5] Chwolsohn, i, 739; ii, 658, 664; ii, 446, 913.
[6] Carra de Vaux, (1), iv, 97; Chwolsohn, ii, 609 f.; Maqrīzī, (1), 674 f.
[7] Havell, (2), 41, 45, 95.
[8] Maqrīzī, (1), 675; Chwolsohn, ii, 394 (al-Dimashqī), 516 (al-Nuwairī) 650.
[9] Chwolsohn, i, 397 f., 496; ii, 649 f., 653, 913.
[10] Chwolsohn, i, 18, 409, 503; ii, 370 (Mas'ūdī); Scott, i, 100 (resemblance to the Mithraic caves).

the planetary gods?) *on the temple walls.*[1] Supplications could be made only through the priests, who alone had the requisite knowledge of the astrological and magical properties of the planets, and knew their Chaldaic, Persian, Greek, Romaic (modern Greek?), Arabic, and Indian names, and also old words, *all* of which must be spoken lest the 'most pleasing' one should be missed.[2] The 'five mysteries' were short allegorical acts, prayers, and speeches.[3]

The astrological beliefs attributed to the Ḥarrānians were mostly the usual ones.[4] They worshipped the *Spirits* of the planets with prayers, sacrifices, and suffumigations.[5] Maimonides[6] reported that the Ṣābians believed that every plant, animal, and metal belonged to a particular star, and that every magical ceremony, formula, and suffumigation was addressed to a star. They take a particular metal, or melt together a certain number of metals under a particular conjunction of the planets, and recite a particular formula, at the same time burning particular incense. Al-Nadīm says they drank from a row of seven cups and wetted their eyes from them.[7] They observed the houses and stations of the planets, their risings and settings, conjunctions and oppositions, and rule over certain hours of the day and night.[8] Some planets were masculine, others feminine (they could marry), some lucky and others unlucky. The ideas are Neoplatonic.[9] The days on which the planets reached their culminating-points were celebrated as festivals.[10] Al-Bīrūnī[11] says that each nation must call the planets by their names in their own language, and he gives the Arabic, Greek, Persian, Syriac, Sanskrit, and Khwārizmīan names. He gives a list of the Ṣābian feasts, statues and idols (Venus, Mars, Atargatis, Saturn, Moon), including the feast of the nuptials of the elements, of bathing, etc.[12] Tammūz in Babel advised the king to worship the seven planets and the signs of the zodiac, but was put to death for this, whereupon the idols from all parts of the world collected that night in the temple of the Sun (Bēl) there and mourned Tammūz, going away at daybreak.[13] Al-Dimashqī[14] says the temple of Tammūz in Jerusalem was surrounded by seven walls, of fire, gold, marble, stone, silver, iron, and copper. Tammūz was a Syrian god, but the legend goes back to the account of the walls of Ekbatana which occured in Herodotos. The worship of the planets and stars, far from being a speciality of the Ḥarrānians,[15] was common to nearly all the heathens called Ṣābians by the Muslims.[16] The Ḥarrānians astrological literature was extensive; 'Izz al-Mulk Muḥammad al-Musabbi'hī (d. A.D. 1029) wrote a book of 6000 pages on the subject.[17]

[1] Carra de Vaux, (1), iv, 98.
[2] Chwolsohn, i, 737 f.; Dozy, (3), 283 f., 298 (Ghāyat); Reitzenstein, (8), 189 (not Mandaean); Saxl, *Islam*, 1902, iii, 157.
[3] Chwolsohn, ii, 45 f.
[4] Thorndike, (1), i, 662.
[5] Chwolsohn, i, 741; ii, 7, 258, 386, 406, 422, 431, 440, 453, 610, 677, 703 (al-Dimashqī, Maimonides, Maqrīzī, Shahrastanī).
[6] *Ib.*, ii, 466 f. (Ibn Waḥshīya).
[7] *Ib.*, ii, 50, 361.
[8] Maqrīzī, (1), 675.
[9] *Ib.*, i, 737 f.; ii, 38, 252.
[10] *Ib.*, ii, 386–7, 500, 525, 530, 676.
[11] (1), 171–2.
[12] *Ib.*, 187, 315–18.
[13] Chwolsohn, ii, 206, 219, 605 (Ibn Waḥshiyā); ii, 206 (Bar Bahlūl, *c.* A.D. 950); ii, 27, 459 (Maimonides), 606–7 (Maqrīzī), 915, 917 (Ibn Waḥshiyā).
[14] (1), 227; Chwolsohn, i, 260; ii, 680.
[15] Bousset, (1), 23; S. Lane Poole, 259; Reitzenstein, (2), 168.
[16] Chwolsohn, i, 20; the *Dabistān*, iii, 105 f., reports that every nation worshipped the planets.
[17] Chwolsohn, i, 457, 545.

The Ṣābians believed that the intermediary between God and men must be a spiritual being, not a human prophet, and these are the spirits of the planets. God cannot be approached directly but only through seven angels or genii, directors of the seven planets and their seven heavens, each spirit having a temple and each temple a heaven; the relation between the spirit and the temple is like that between the soul and the body. The idols were the approachable representatives of the invisible spirits and the (not always visible) planets, and must be of the form, shape, material, colour, and number corresponding with them, since only then were the 'powers of the stars' poured down over the idols.[1] The seven planets are 'rulers' and 'gods', the sun being 'god of gods' or 'lord of lords'.[2] The idols must be constructed of the appropriate materials by an artificer who is a theurge or alchemist.[3] It is useful in asking for a wish to be fulfilled to address an appropriate god or a divinity still friendly to him, e.g. Venus when a gift from Mars is required, or vice versa.[4] It is best, if possible, to address the planet under which one was born; the worshipper must be externally and internally purified, with pure soul, and without low or selfish thoughts; the supplication must be made at the right time, viz. the first hour of the particular day of the seven-day week corresponding with the planet, during its culmination, and with a favourable station and conjunction:[5] 'Do not ask of a planet what is not of its nature.'[6] There were ceremonial prayers, to be repeated and ending 'Amen', conjurations, and sacrifices, in which the material and colour of the robes and rings worn, the nature of the incense, sacrificial animals, the plants and metals used in the ceremonies, and correct numbers, are laid down (Neoplatonic ideas).[7] Al-Nadīm[8] speaks of a priest shooting twelve incendiary arrows from a bow, which he retrieved by going on all fours like a dog, and repeating the process fifteen times; if an arrow was extinguished it was a bad omen. There are signs of this practice in the West (πυρομαντεία).[9]

According as one assumes seven (the planets) or nine (the planets plus earth and air) spheres,[10] so seven or nine lambs are sacrificed,[11] and the altars or pedestals of the idols must have the corresponding numbers of steps.[12] The conjurations contain several magic words, perhaps of Greek origin and the planetary spirits have secret names, some apparently Hebrew (Saturn = Ishbīl, Jupiter = Rūfāīl, Mars = Rūbāīl, Venus = Bātāīl, Mercury = Harkīl, Moon = Salbaīl).[13] Al-Dimashqī[14] says the Ṣābians believe that the planets influence everything by their positions, movements, forces, and particularly their colours. Their rays produce the corresponding metals and precious stones in the interior of the earth, the Sun producing (yellow) gold, Saturn (black)

[1] Chwolsohn, i, 739; ii, 439 f., 478, 609, 709, 714, 720.
[2] Maqrīzī, (1), 674 f.
[3] Chwolsohn, ii, 436, 659, 709, 712, 895.
[4] Chwolsohn, ii, 247 (a Greek idea); Dozy, (1), 343.
[5] *Ib.*, i, 203 (Abū Ṣa'īd), 541 (7-day week), 737 f.; ii, 173 (planetary week); Dozy, (3), 349.
[6] Dozy, (3), 344.
[7] Chwolsohn, i, 737 f., 742 f.; ii, 433, 708 (Shahrastānī); Dozy, (3), 349 f.
[8] *Ib.*, ii, 26, 198 f. (cf. *ib.*, 30, a bird carrying a torch).
[9] *Ib.*, ii, 227.
[10] *Ib.*, ii, 376 (Mas'ūdī).
[11] *Ib.*, ii, 24 (al-Nadīm).
[12] *Ib.*, ii, 383 f. (Dimashqī), 672 f.
[13] Dozy, (3), 296, 352 f.
[14] (1), 41 f., 47 f., 63, 71; Chwolsohn, i, 544; ii, 400, 411, 648 f. (sources), 656, 658 f., 671, 681, 695; Carra de Vaux, (1), iv, 96; Saxl, *Islam*, 1902, iii, 150.

lead, etc. The relation between the planets and metals in Ṣābian accounts had been noticed in 1648 by Salmasius.[1] Al-Nadīm[2] gives the order of the planets their Ṣābian (partly Greek, partly Babylonian) names as: Sun (Iliūs, Ἥλιος), Moon (Sīn), Mars (Aris, Ἄρης), Mercury (Nabūq, Nabu), Jupiter (Bāl), Venus (Balth'ī, Βῆλθις), and Saturn (Qrunus, Κρόνος). Al-Maqrīzī[3] gives the order and day of worship as: Saturn (Saturday), Jupiter (Sunday), Mars (Monday), Sun (Tuesday), Venus (Wednesday), Mercury (Thursday), Moon (Friday). The number of steps on the throne or pedestal of the idol[4] were significant. The following details are from al-Dimashqī,[5] who also gives the appropriate human sacrifices and prayers.

	SATURN	JUPITER	MARS	SUN	VENUS	MERCURY	MOON
shape of temple	hexagon	triangle	square	square	long triangle	hexagon in square	pentagon
colours of temple	black	green	red	yellow	blue	various	golden and white
colour of dies	black	green	blood-red	yellow, with jewels	white	various ?	white
metal of idol	lead	tin	iron	gold	copper	{all mals *khār sīnī*	silver
day of worship	Saturday	Thursday	Tuesday	Sunday	Friday	Wednesday	Monday
steps to throne	9	8	7	6	5	4	3

The planetary order is the same in several Greek alchemical MSS., including a Greek translation of Abū Ma'shar (Albumasar, 9 cent. A.D.),[6] and also in a modern Indian work on astrology giving the same metals, the *Makhzan al-Adwiyah*, by Muḥammad Ḥusain, the metal of Mercury being *safīd rūy* (white bronze, zinc).[7] The metals are the same in the Greek except that Mercury is associated with ἤλεκτρος (electrum, properly an alloy of gold and silver) and ὑδράργυρος (mercury, quicksilver). In al-Dimashqī[8] three metals are associated with Mercury: 'This idol is made of all the metals (*ma'din*) and of *khār ṣīnī* and it is made hollow. In the hollow much quicksilver (*zibāq*) is poured.' Chwolsohn translated *khār ṣīnī* as 'Chinese clay (Thon)', Mehren as 'Chinese porcelain'; Stapleton[9] left it untranslated, with a discussion. He added 'an alloy of', which is not in the Arabic text, before 'all the metals', which may mean either the separate metals, as used in the statue of Serapis in Alexandria (see p. 170),[10] or an alloy, 'mixed metal',[11] perhaps electrum,

[1] (4), unpaged pref., 37 f. (q. Maimonides): 'Zabei vel Zabii . . . dicit nullum esse Deum praeter Stellas . . . Stellis statuas et simulaera constituebant et Soli quidem aurea Lunae argentea, aliis planetis ex illis metallis.'
[2] Chwolsohn, ii, 22.
[3] *Ib.*, 611.
[4] *Ib.*, 34, 243 (al-Dimashqī), 673 (do.).
[5] (1), 41 f.; Carra de Vaux, (1), iv, 96; Chwolsohn, ii, 381 f., 411 f., 608 f. (Maqrīzī), 647 f.; Dozy, (3), 285 f.; Stapleton, (4), 398.
[6] Berthelot, (2), i, 79; ii, 24.
[7] Stapleton, (4), 404, 407; al-Rāzī distinguished *khār ṣīnī*.
[8] (1), 45; Chwolsohn, ii, 396.
[9] (4), 401 f., 407.
[10] Rufinus, *Hist. Eccles.*, ii, 23; Chwolsohn, ii, 685.
[11] Maimonides, in Chwolsohn, ii, 466, 730: from Ibn al-Waḥshīya or the book of Ṭumṭum the Indian, Lippmann, (2), i, 256, 404, 412.

bronze, or brass.[1] There is no ambiguity about the second metal, mercury or quicksilver (*zibāq*).[2]

Ibn al-Waḥshīya (*c.* A.D. 912)[3] in a list of symbols for minerals, gives the planetary symbols (tne last three are not quite the usual ones) for gold, silver, lead, iron, and tin ('white lead'), but the symbol for quicksilver (*zibāq*) is different, a white star in a black circle. Ibrāhīm ibn Waṣīf-Shāh (*c.* A.D. 1205)[4] says King Naqrāus in Egypt built idols of the seven planets: Saturn, Jupiter, Mars, Sun, Venus, Mercury, Moon. One of these idols was of solidified quicksilver (*zibāq*), and in the temple with it was a table of white salt and solidified quicksilver, with legs of yellow quicksilver and on it a vase of red quicksilver. The idols in this temple, at Armant in Egypt, were of mineral bodies having the nature of the stars and classifiable according to their order, as was explained in a Coptic book.[5]

Al-Dimashqī also[6] speaks of 7 planets, and 7 metals having, according to the Ṣābians, their colour, nature, quality, and speciality (ṣayyā); only six planets and metals are given, Mercury and its metal being missing, but in corresponding lists in Muḥammad ibn Aḥmad al-Khwārizmi (*Mafātīḥ al-'ulūm*, A.D. 976),[7] al-Qazwīnī (*'Ajā'ib al-makhlūqāt*, *c.* A.D. 1275?),[8] and Ibn Mansur (13 cent.),[9] the seventh metal is *khār ṣīnī*, which is probably zinc. The white robes which were worn when worshipping Venus recall those of the priests of the Syrian goddess (Dea Syria), identified by the Greeks with Aphrodite (Venus),[10] and the numbers of steps correspond with the old order of distances of the planets from the earth.[11]

Pictures of the planetary gods in a MS. of al-Qazwīnī and descriptions in al-Dimashqī, e.g. Mars a warrior with helmet and sword, Venus a zither-player, Mercury a scribe with a roll (not a book) on his knees, etc., may go back to old Babylonian (or at least, Hellenistic) originals.[12] There are descriptions of the forms of the planetary gods in the Persian *Dabistān* (17 cent.), quoting the *Akhtaristān* of an unknown author and date,[13] with accounts of the temples of the seven planets, the forms of the idols, colours of the priests' garments, materials of their rings, the kinds of incense used, the tastes of the foods offered, etc. (see table overleaf).

Al-Dimashqī[14] says Saturn was represented as a black Indian old man holding an axe, a similar man holding a rope attached to a bucket with which he drew water from a stream, a man meditating on ancient hidden wisdom, a

[1] Hoffmann, in Ladenburg, (1), ii, 528.
[2] Lippmann's doubts, (2), i, 256, are based on Mehren's incorrect translation 'Chinese porcelain', known only from the 9 cent. A.D.
[3] (1), text 108 f., tr. 36 f.; Chwolsohn, ii, 839.
[4] Carra de Vaux, (3), 10, 12 f., 178, 208.
[5] *Ib.*, 178, 248, 251–2.
[6] (1), 53 f., 60; Chwolsohn, ii, 411 (text marked as incomplete).
[7] Wiedemann, *Sitzb. Erl.*, 1904, xxxvi, 309 (342–3); 1911, xliii, 72 (80–1).
[8] (1), 427.
[9] Wiedemann, *Sitzb. Erl.*, 1912, xliv, 205 (209).
[10] Loukian, *De Syria Dea*, 42; *id.*, (5), 79; Chwolsohn, ii, 683.
[11] Chwolsohn, ii, 243, 673.
[12] Chwolsohn, ii, 388 f., 660 f.; Saxl, *Islam*, 1902, iii, 150.
[13] *Dabistān*, I, i–cxcvii, 35–42; Chwolsohn, ii, 668, 675–87, 711; Sir J. Malcom, *The History of Persia*, 1875, i, 186, and plate.
[14] (1), 414; Chwolsohn, ii, 382 f., 671; Stapleton, (4), 399.

	SATURN —	JUPITER (Hormuzd)	MARS (Bahram)	SUN —	VENUS (Nahid)	MOON (Mah)	MERCURY (Tir)
temple	blackstone	—	red stone	gilt bricks	white marble	green stone	blue stone
image	black stone	earth colour	red stone[1]	burnished gold[2]	red man	man on white ox	blue stone
garments	blue	yellow and white	red	yellow gold tissue	white	green and white[4]	blue
	iron	silver and carnelian	copper	—[3]	diamond	silver	gold
incense	myrobalans	laurel berries etc.	sandarach etc.	sandal wood	saffron	gum arabic etc.	gum mastic

1 with red crown, an iron verge in the left hand; 2 ruby crown with 7 peaks, gold sceptre; 3 girdle of rubies, diamonds, etc.; 4 green is a very old lunar colour (cf. 'moon of green cheese').

woodworker, or a king riding on an elephant. He also reports from al-Mas'ūd, that Ṣābians went on pilgrimages to a temple of Saturn built by the Indian Māshān in the land of Sindānī Sindān was 10 parasangs (about 33 miles) from the capital city al-Manṣūrah, called by the Indians Brahmanābād (about 40 miles N.E. of Hyderabād).[1] The Ghayāt[2] gives the following list:

	SATURN	JUPITER	MARS
garment	black	white	yellowish-red
ring	iron	crystal	copper
incense burner	iron	—	copper
sacrificed animal	black goat	white sheep	—

No incense is used with Jupiter; that for Mars contains human blood, and directions for preparing incense for the other planets are given. It is said[3] that the nature of Mercury is variable and can approach that of other planets. Saturn is the patron of Jews.[4] Some attribute iron, not copper [red] to Mars, those who work iron being ruled by the planet; the Sun is the planet of the noble metals and of those who separate them from minerals.[5] Mas'ūdi attributes both lead and iron to Saturn.[6] Chwolsohn[7] recognised the Neoplatonic association of metals and planets, but thought it was older and more complete among the Ṣābians (he does not mention Celsus).

The account of Ṣābian beliefs given by Abū-l-Fatḥ Muḥammad al-Shahrastānī (A.D. 1076/7–1153)[8] represents them as a modified pantheistic Neoplatonism like that of Iamblichos, with theories of the soul of the universe, active or male and passive or female principles, a relation of all natural phenomena by spiritual sympathy, formulae, and theurgical and magical ceremonies which could compel the will of spiritual beings, of which the

[1] Mookerji, (2), 93, reports a temple of Saturn in Calcutta; the ruined temple of Konarak in Orisā in legend was built by Śamba to worship the planets, and some Ṣābian names of planets may be Indian.
[2] Dozy, (3), 352, 359. [3] *Ib.*, 348. [4] *Ib.*, 350. [5] *Ib.*, 342, 347.
[6] Chwolsohn, ii, 671; see Bede's list, No. 8. [7] i, 744; ii, 659; Bousset, (1), 25.
[8] *Religionsparthien und Philosophenschule*, tr. T. Haarbrücker, 2 vols., Halle, 1850–1; Chwolsohn, i, 679 f.; ii, 415 f., 699 f.; Reitzenstein, (2), 171 f.

planets are receptacles. These may be the views of the learned Ṣābians, although they include idols in temples; metempsychosis, the end of the world and its renewal (Stoic), a sharp distinction between matter and spirit, etc., may be later additions. The chief authorities are 'Adīmūn (Agathodaimon) and Hermes. The philosophical views may be those of Chwolsohn's third group, e.g. Neoplatonic and Hermetic works, mistaken for Ṣābian, but they are mostly Aristotelian.[1]

There are five primitive beings (elements, στοιχεῖα), two active (creator and soul), one passive (matter, ὕλη), and two (time and space) neither active nor passive.[2] Intermediaries, of a spiritual nature, emanated from god like rays of light from the sun, and mediating between god and man or anything with a partly material nature, include *logos* (λόγος) and *dynameis* (δυνάμεις), the former being the implement and servant of god[3] in the sense used by Philo Judaeus (see p. 180). They also include the first cause (πρῶτον αἴτιον) and the highest intelligence (πρῶτος νοῦς) of Iamblichos, the intellectual substance, necessity, the order of the universe, souls, etc.[4] The most important of these 'middlemen' were the 'leaders' (gods) of the seven planets, the 'seven limbs of god', which influence and rule the world.[5] They are the 'fathers' of the elements, which are the 'mothers' of all separate things.[6] Their bodies are the seven planets and they are worshipped as 'spirits' of these.[7] These spirits are partly male and partly female and can marry, and partly androgyne (as Sin, the moon); partly beneficent and lucky, bringing happiness, partly evil and bringing ill-fortune.[8] They, and the intellectual substance, are worshipped in temples, the oldest built by Abraham.[9]

To obtain Muslim tolerance, the Ḥarrānians must have a Prophet and a Holy Book. As their prophet they named mostly Hermes (Hurmus), as their book either the Hermetic Books (from which some beliefs reported by Shahrastānī were taken), or forged or even imaginary books ascribed to Hermes. On such a foundation an astonishing edifice of legends was erected. Al-Kindī's mention of Hermes, Agathodaimon, Asklepios (Imhotep), and Ṭat the son of Hermes, and al-Sharastānī's statement that the Ḥarrānians had a 'world period' of 36,425 years (25 Sothis periods of 1461 years = 36,525)[10] suggest an influence of Egyptian Hermetic religion, which was at its zenith in the 2–3 cents. A.D., and the temple of the 'First Cause' may have had a similar origin, although the seven planets and their relations to colours, metals, etc., is late Babylonian (Chaldaean).[11] The Ṣābians probably knew the Hermetic Books, which Ephrem Syrus (4 cent. A.D.) says were read in Syria in A.D. 365, although hardly any excerpts from them are found in Arabic

[1] Bousset, (1), 23; Carra de Vaux, (1), iv, 94–102; Chwolsohn, i, 485, 679, 740, 750, 764; ii, 12, 125, 418, 421, 427, 430, 439, 444, 488, 721; W. Scott, (1), iv, 248.
[2] Chwolsohn, i, 749 f.; ii, 421, 424, 492 (al-Khāthibī).
[3] *Ib.*, i, 488, 679 f. (Mas'ūdī), 724 f., 726, 734 f.; ii, 421, 442 f., 702 (Shahrastānī).
[4] Carra de Vaux, (1), iv, 96 f.; Chwolsohn, i, 225 (Ibn Sīnā); ii, 367, 381, 439, 446, 609, 718.
[5] Chwolsohn, i, 209, 225, 718, 738; ii, 430 f., 714 (mostly from Shahrastānī).
[6] *Ib.*, ii, 422.
[7] *Ib.*, i, 734; ii, 430 f., 674, 703 (Shahrastānī).
[8] *Ib.*, ii, 38, 183 f., 273 (al-Nadīm).
[9] *Ib.*, i, 17, 210; ii, 369, 477.
[10] *Ib.*, ii, 419, 421, 425, 434, 436 (Fira'un = Pharaoh), 439, 443 (36,425 years), 445, 791.
[11] Bousset, (1), 23 f.

authors, only Suhrawardī (d. A.D. 1191) showing detailed knowledge of them; the name of Hermes was well known to the Muslims down to his time.[1]

Abū'l-Fida[2] and Maqrīzī[3] say the founders of the Ṣābian religion were Seth (Shīth), whose book they possessed, and Idrīs (Hermes); Seth was identified with Agathodaimon ('Adīmūn) and Idrīs and Seth with a first and second Orpheus. Other supposed founders were Solon, Homer, Abraham, Ṭat (of the Hermetic Books), Zoroaster (the same as Nimrud), Buddha, Asklepios (Asqlābiūs), and even Aratos (Arāṭūs) the astronomer.[4] In the *Qur'an* Idrīs is identified with Enoch (Akhnukh);[5] he was also identified with Andrew the Apostle,[6] and with the cook Andrew in the Alexander Legend,[7] but he is usually Hermes.[8]

Hermes and Agathodaimon wrote their secrets on stela from which they were translated into Greek by Bitys;[9] Pythagoras and Plato got their wisdom from them.[10] Hermes Trismegistos, a prophet and philosopher (or astronomer), king of Persia or Upper Egypt, wrote many books on magic, astronomy, astrology, medicine, etc.[11] Alexander the Great was 'Hermes son of Philip', or 'Hurmus ibn Yunān' (the Ionian), and was descended from him.[12] Hermes Trismegistos was the same as the Babylonian 'Utarid (Mercury).[13] Būdhāsaf or Būdāsp (Buddha) in India invented the Persian script and preached the Ṣābian religion, and Ṣābians were identified with the Buddhists of China.[14] The description of the idol in the temple of the Soul in Dimashqī[15] as having 'many different heads and many hands and feet', suggests a Hindu god.

Hermes ascended to the outermost sphere of Saturn, lived there for thirty years (the period of revolution of the planet), and inspected the whole solar system. He then returned to the earth full of astronomical knowledge,[16] with which he predicted the coming of the Flood, and buried his treasures and books in the pyramids. These, 'like all Egyptian temples', had seven chambers consecrated to the seven planets, on the walls of which were magic, astronomical, astrological, medical, alchemical, and other inscriptions.[17] Hārūn al-Rashid (A.D. 786–809) had one opened with fire and vinegar, but found only a few gold coins in a green jar.[18]

[1] Chwolsohn, ii, 13 (al-Kindī q. by al-Nadīm), 126; Massignon, in Festugière, (1), 384–400; W. Scott, (1), i, 101–2, 109–10.

[2] Chwolsohn, ii, 499.

[3] (1), 674.

[4] Alfaric, i, 2, 6; ii, 153, 320; Chwolsohn, i, 17, 246, 259, 268, 628, 635, 641, 781 f., 793; ii, 4, 608, 623 f., 635 f.; Dimashqī, (1), 33 f., 46, 205; Dozy, (3), 292; Reitzenstein, (2), 166 f., 173, 365.

[5] Chwolsohn, i, 789 f.; ii, 621; W. Scott, (1), i, 101.

[6] Wiedemann, *Sitzb. Erl.*, 1906, xxxviii, 181 (194).

[7] J. Horovitz, (1), 88.

[8] Chwolsohn, ii, 421–5, 433–9; A. J. Wensinck, *Ency. Islam*, ii, 449.

[9] Iamblichos, *De Myst.*, x, 7; Parthey, (3), 293.

[10] Pietschmann, (1), 41, 57; Reitzenstein, (2), 66 (al-Qifṭī).

[11] Chwolsohn, i, 17, 361, 789 f.; al-Dimashqī, (1), 23, 33.

[12] Dimashqī, (1), 371; the Egyptians and Persians made Alexander descend from their own kings.

[13] Chwolsohn, ii, 621 (Mas'ūdī).

[14] Alfaric, ii, 213; Al-Bīrūnī, (1), 186; Chwolsohn, i, 214.

[15] Chwolsohn, ii, 382, 653.

[16] F. Dieterici, (1), iii, 67; Reitzenstein, (2), 175.

[17] Maqrīzī, in Dimashqī, (1), 32, 35.

[18] Mas'ūdī, in Reitemeyer, (1), 94.

Agathodaimon-Seth was a Graeco-Egyptian prophet, either a thousand years older than Hermes, or the teacher of Hermes, or his disciple and pupil.[1] From this confusion (typical of Muslim historians) arose a belief that there had been several persons called Hermes: (1) an Egyptian, or two, of Upper and Lower Egypt, who founded the Egyptian religion; (2) a Babylonian, one of the seven servitors of the temple of 'Utarid (Mercury), who visited Egypt and taught astrology and occult sciences to the priests of Memphis; (3) Hermes Trismegistos; (4) Hermes the Ancient (al-awwal), a Hebrew, also called Idrīs or Enoch (Khunūkh), who invented all the known sciences before the Flood.[2] Al-Nadīm said Hermes had seven sons; he and his wife (or a son) were buried in the two great pyramids;[3] Mas'ūdī said these are the tombs of Agathodaimon and of Hermes who lived about a thousand years after him, whom the Copts, conformably to the opinions of the Ṣābians, regarded as prophets.[4] The third pyramid is the tomb of Ṣābī ibn Hurmus or Sāb ibn Idrīs, son of Hermes, after whom the Ṣābians are called.[5] Shahrastānī, however, reported that the Ṣābians believed that Hermes ascended to heaven.[6] Hermes (or Idrīs) and Agathodaimon are quoted in the *Dabistān*[7] and often by the Persian poet Shirāzī (d. A.D. 1640).[8]

[1] Carra de Vaux, (2), 68; Chwolsohn, i, 243 (al-Qifṭī), 254 (Abū'-l-Faraj), 492 (Abū'-l-Ṣalt) 780 f. (ibn Khurdādhbih), 792; ii, 604 (Maqrīzī), 825 (Ibn Waḥshīya); Pietschmann, (1), 48; Reitzenstein, (2), 129. Al-Dimashqī disbelieved these stories: (1), 47; Chwolsohn, i, 259.

[2] Berthelot, (4), iii, 26; Chwolsohn, i, 243, 521, 636, 644, 780 f., 787 (Abū Ma'shar), 791; ii, 529 (Ibn Ṣā'id, al-Qifṭī, Ibn abī Uṣaibi'a, Abū'l-Faraj, Ibn Baṭṭūṭah (14 cent.); A. Kircher, (1), i, 116, 148; (3), 216; L. Leclercq, i, 196; Massignon, in Festugière, (1), i, 384 (390); Reitzenstein, (2), 173, 175.

[3] Chwolsohn, i, 787 f.

[4] Carra de Vaux, (4), 28 f.; Chwolsohn, ii, 604, 617, 629.

[5] Chwolsohn, i, 199, 228, 251, 493 (Ṣābī), 636, 643, 780; ii, 604; Reitzenstein, (2), 166. The Ṣābians are here confused with the ancient Egyptians: Chwolsohn, i, 234, 544.

[6] Chwolsohn, ii, 437; a Hermetic belief, Reitzenstein, (2), 171.

[7] iii, 105 f.

[8] Horten, *Islam*, 1913, Suppl. ii, 14, 16, 146–7, 242, 254.

CHAPTER XX

THE QABBALAH

The Jewish *Qabbalah* (from *qabbal*, to receive) is a theosophical 'doctrine received by oral tradition', teaching a correspondence between celestial and terrestrial things, the doctrine of the macrocosm and the microcosm, that En Soph (God) sent forth ten emanations (Sefiroth) which are related to planets, elements, colours, etc., and that the Hebrew letters have magic powers and their numerical values produce words of equal numerical value standing to one another in a mystical relation.[1] The letters of the alphabet[2] in Greek and Hebrew have numerical values; two words having equal numerical values (isopsephic) can be regarded, in a mystical sense, as having the same meaning. The basis of the *Qabbalah* is the Pythagorean *tetraktys* or number 4 (see p. 12). Since $1+2+3+4=10$, this is also a powerful number. Odd numbers are in general more powerful than even and the fourth odd number, 7, is very potent. It was perhaps this derivation, rather than the Babylonian planetary number 7 which entered the *Qabbalah*. Important numbers of obvious origin are $4\times7=28$, $7\times7=49$, and $3+5+7=15$.[3] This procedure was well known in the Hellenistic period; Hippolytos[4] mentions it.

The use of Hebrew letters to represent numbers is relatively modern and is unknown in the Old Testament.[5] It is not known whether it was derived from the Greek

[1] E. Bischoff, *Die Kabbalah*, Leipzig, 1903; L. Blau, JE, v, 681 (Gnosticism); Broydé, JE, xi', 689 (Zohar); Bouché Leclercq, 537, 600; Brucker, (1), 1766, ii, 916–1068 (De Philosophia Judaeorum Cabbalistica; for infl. on Henry More, 980, and on J. B. van Helmont, 981; the Sefiroth, 1015: Brucker gave twelve explanations of the Sefiroth, religious, philosophical, demonological, astronomical, astrological, physical, logical (!), arithmetical, methodological, alchemical, political, and messianic; Budge, (4), 218, 281, 366, 389, 394; Deussen, (1), II, ii (1), 417, 421; Dornseiff, 35, 139 f., 143; Eisler, (1), 741; (2), 116, 124, 268; *id.*, *A. Rel.*, 1914 xvii, 339; Farbridge, 20, 94, 123; A. Franck, *La Cabbale, ou la philosophie réligieuse des Hébreux* 1843 (and 1889); J. Fürst, *Bibliotheca Judaica*, 3 pts., Leipzig, 1849–63; M. Gaster, (1) ERE iii, 454 (alchemy); xii, 858 (Zohār); (2) *id.*, JE, i, 328–32 (alchemy); C. D. Ginsburg, (1) *The Kabbalah, its Doctrines and Literature*, 1865 (2 ed., unaltered, 1920); *id.*, (2), DCB, i, 356 Ginzberg, (1), JE, xii, 602 (Sefer Yeẓîrah); (2), *id.* and Kohler, JE, iii, 456–79 (Cabbala); Hausrath, (1), i, 113 f.; W. Hesz, *A. Nat.*, 1916, vii, 117; Hoefer, (1), i, 247; Jacoby, HDA, 1932, iv, 666 (Sepher Jezîrah), 898 (Kabbalah); A. Jellinek, *Beiträge zur Geschichte der Kabbala*, 2 vols., Leipzig, 1852; D. H. Joël, *Die Religionsphilosophie des Sohar*, Leipzig, 1849; S. Karppe, *Étude sur les Origines et la Natur du Zohar*, 1901; Kennedy, 43 f., 62; Kopp, (4), ii, 228–46; P. Kraus, (1), *Islam*, 1931, xix, 242 (262); *id.*, (2) MIE, 1942, xlv, 266; A. Lehmann, 132; H. Loew, ERE, vii, 622–8 (Ḳabbālā); E. Müller, *Jud. Lex.*, 1929, iii, 504 (Kabbala); S. Munk, (1), 273, 490; Noack, (1), 462–6; H. Rom, *Jud. Lex.*, i, 195–200 (alchemy); Sarton, (1), ii, 366, 730, 878; III, x (S. Gandz); G. Scholem, (1) *E. Jud.*, 1932, ix, 630–731 (Kabbalah; bibl.); (2) *Bibliographia Kabbalistica*, Leipzig, 1927; (3) *Die Geheimnisse der Schöpfung, eine Kapitel aus dem Zohar*, 1935; W. Schultz, 197; Stein, JE, ii, 45 (Arabic-Jewish philosophy); A. E. Waite, (1), (2); A. Wünsche, RPTK, 1901, ix, 670–89.

[2] Gow, DA, ii, 72; Hoefer, (4), 74–8; Salmon, DCB, ii, 161.

[3] Eisler, (1), 741; (2), 116, 124, 268; Hausrath, (1), i, 114; Legge, (1), i, 105, 169.

[4] *Refut.*, iv, 14.

[5] S. R. Driver, *Notes on Samuel*, Oxford, 1890, 75; Hoefer, (4), 62; the parts of Psalm 119 are numbered by Hebrew letters in the A.V.

numerals and a supposed Phoenician origin is unsupported by inscriptions.[1] The Babylonians, who were good mathematicians, assigned numbers of rank to gods (Nebo, god of wisdom, being lowest), and this idea may have been picked up by the Jews in the Captivity.[2] Gematria (Hebrew *gemaṭrya*, from γεωμετρία), as this letter calculation was called, is an essentially Jewish method, the Greeks making little use of it.[3] In a 5–6 cent. A.D. Oxyrhynchus papyrus, 'amen (αμην)' = 99 is replaced by ϙθ = 99.[4]

The *Mishnah* and *Talmud* were put into writing only in the Middle Ages but may have been transmitted earlier by oral tradition.[5] The *Qabbalah* consists of two parts, *Sefer Yeẓīrah* and *Zohar*. It has been alleged to date back before the Flood and most Jewish scholars think it goes back to 'old oral traditions' of quite uncertain date.[6] Its antiquity was denied by Petrus Garsias,[7] who said that it is derived from the *Talmud* rather than the Old Testament, and that its doctrines contradict the proper interpretation of the Bible.[8] The *Qabbalah* was enthusiastically expounded as an ancient book by Johann Reuchlin,[9] who favoured occult sciences and the virtues of words and numbers,[10] and by Johann Pistorius (1544–1607), a confessor to the Emperor Rudolph II and a doctor of theology and medicine.[11] The spurious character of the *Qabbalah* was emphasised by Jean Morin (see vol. II, p. 466).[12]

The *Sefer Yeẓīrah* (Book of Creation) in its present form was composed in the 9 cent.[13] One of the best informed scholars[14] thinks it originated either in Palestine or (more probably) Babylonia in the 3–6 cents. A.D. and was worked up from the 8 cent. in Italy, Spain, and France. It was printed in Mantua in 1562, a Latin translation in Paris in 1552, and a commentary on it was composed in Arabic in A.D. 931 (or 934) by Sa'adyā Gaon al-Fayyūmī in Baghdād.[15]

The *Sefer ha-Zohar* (Book of Splendour) was written by Moses ben Shem-Ṭob (Leon, Spain, *c.* 1250–Arevalo, 1305), partly in Hebrew and partly in imitation of an obsolete Aramaic dialect; his ascription of it to Simeon ben Yoḥai (A.D. 70–110) is fraudulent.[16] Munk says it was probably influenced by the *Fons Vitae* of ibn Gabirol (Avicebron) (1021–1058); the foundation may be old *Midrashīm* now lost but the work includes Egyptian, Babylonian,

[1] Gow, DA, 1914, ii, 72.

[2] Budge, (4), 213; Legge, (1), ii, 35; Meissner, ii, 13, 20, 322, 385 f.

[3] S. A. Horodezky, *E. Jud.*, 1931, vii, 170 (Gematria).

[4] Sarton, (1), iii, 122.

[5] Albright, 34; H. Danby, *The Mishnah*, Oxford, 1933; *The Babylonian Talmud*, tr. I. Epstein, 11 vols., 1948–52; Partington, (1), 479 f.

[6] Budge, (4), 218, 354, 366 f., 373 f., 385, 403; Deussen, (1), II, ii, (1), 417 f. (in Philo's time); Dieterich, (1), 161; Eisler, *A. Rel.*, 1914, xvii, 340; Gaster, ERE, xii, 858; Holtzmann, *A. Rel.*, xxiv, 126; J. Matter, (1), 1828, i, 74 f., 96, etc.

[7] *Determinatiões Magistrales*, f°, Rome, 1489.

[8] Thorndike, (1), iv, 506.

[9] *De Verbo Mirifico*, f°, Basel, 1480; Tübingen, 1514; 8°, Cologne, 1532; Lyons, 1552; *De Arte Cabalistica libritres*, f°, Hagenau, 1517; both books were on the Index.

[10] Thorndike, (1), iv, 524; vi, 147–8.

[11] *Artis Cabalisticae hoc est reconditae theologiae et philosophiae scriptorum*, f°, vol. 1 (all publ.), Basel, 1587; containing trs. of several Hebrew works.

[12] *Exercitationes Biblicæ*, 4°, Paris, 1633.

[13] S. Gandz, in Sarton, (1), III, x, claimed that its material should be dated 100 B.C.–A.D. 100, that it was regarded as 'ancient' in A.D. 200, and that it is not *Qabbalah*; *sefirot* are numbers and have little to do with spheres of emanation; God created the world by means of the 10 numbers and the 22 letters of the Hebrew alphabet.

[14] G. Scholem, (1), 644.

[15] Sarton, (1), i, 627 (Sa'adyā b. 882 not 892 as Sarton says); ii, 367.

[16] Ginsberg, (2), 363; Munk, (1), 273 f., 490 f.; Salmon, DCB, ii, 681; Sarton, (1), ii, 878.

Greek, Hellenistic, gnostic (Basileides and Valentinian) and even Arabic material. The *Zohar* in Hebrew has been printed many times, first in Mantua (3 vols. 4°, 1558–60), and Cremona, 1559; no MS. earlier than this is extant but the work was apparently known to Ramon Lull (d. 1315)[1] and was quoted in the 15 cent. by Pico Mirandola. It influenced many non-Jewish thinkers.[2] Wünsche says the *Qabbalah* was produced mostly in Provence and developed in two stages: (i) in the 7–13 cents., and (ii) in the 14–18 cents., some parts being almost modern. Scholem[3] thinks the *Zohar* contains layers of material going back to A.D. 1240–80. There are complete translations[4] and a Latin translation of parts by Christian Knorr von Rosenroth[5] (Silesia, 1636–Sulzbach, 1689), who travelled in France, Holland, and England, and was particularly interested in oriental languages and alchemy; he was a Christian and an associate of F. M. Van Helmont, and translated works of Sir Thomas Browne and Leibniz into German.[6] Part of the *Kabbala Denudata* was translated into English.[7] The interest taken in the *Qabbalah* by Franciscus Mercurius Van Helmont (see Vol. II, p. 242) was spread by his visit to England and by translations of his books.[8]

The essential idea of the macrocosm and microcosm is expounded in the *Sefer 'Olam ha-Qaṭan* (Book of the Microcosm) by Joseph ben Ẓaddiq of Cordova (d. 1149),[9] and in the *De Mundi Universitate Libri Duo, sive Megacosmus et Microcosmus* of Bernard of Tours (fl. 1150), which is based on Plato and Neoplatonic works (he also wrote on astrology).[10] The *Bāhīr*, ascribed to Isaac the Blind (*c.* 1175) or his school, contains the doctrine of emanations, but its authorship is doubtful and it is not mentioned till the end of the 13 cent.[11]

[1] Sarton, ii, 880.
[2] J. L. Blau, *The Christian Interpretation of the Cabala in the Renaissance*, New York, 1944.
[3] (1), 654.
[4] *The Zohar*, tr. H. Sperling and M. Simon, 5 vols., London 1931–4; *Sepher ha-Zohar (Le Livre de la Splendeur) Doctrine Ésotérique des Israélites Traduit pour la première fois sur la Texte Chaldaïque et accompagné des Notes par Jean de Pauly. Œuvre Posthume entièrement revue, corrigé et complétée. Publié par les soins de Émile Lafuma-Giraud*, 6 vols., Paris, 1906–11 (the tr. was corrected, 'par un savant compétent', with the Hebrew ed., Mantua, 1559, and Eisler, *A. Rel.*, 1914, xvii, 339 f., says it is careful and accurate).
[5] *Kabbala denudata seu doctrina Hebraeorum transcendentalis et metaphysica atque theologica*, vol. i, 4°, Sulzbach, 1677, containing 740 pp. of text followed by *Apparatus in Librum Sohar*, 312 pp., and *Liber Porta Coelorum*, 192 pp.; vol. ii, 4°, Frankfurt, 1684, 598 + 478 pp.; followed by *Porta Coelorum*, pp. 195–256 (in copy seen), Sulzbach, 1678, and *Adumbratio Kabbalae Christianae*, Frankfurt, 1684; the whole interspersed with prefaces and indexes. The translation is said not to be very exact. The *Adumbratio* ~~is very~~ rare. Parts of alchemical interest are I, pp. 151, 184, 206 f., 241, 298 f., 346, 441, 483, 528 f., 570, 625.
[6] J. F. Buddeus, *Introductio ad Historiam Philosophiae Ebraeorum*, Halle, 1702, 223–45.
[7] S. L. MacGregor Mathers, *Kabbala denudata: the Kabbalah Unveiled containing the following books of the Zohar*: (1) *the Book of Concealed Mystery* (2) *the Greater Holy Assembly* (3) *the Lesser Holy Assembly. Translated into English from the Latin Version of Knorr von Rosenroth, and Collated with the original Chaldee and Hebrew Text*, 1887, pp. viii, 359 (these are said to be the most obscure parts of the *Zohar*).
[8] F. M. Van Helmont, *A Cabbalistical Dialogue in Answer to the Opinion of a Learned Doctor in Philosophy and Theology, that the World was Made of Nothing. As it is Contained in the Second Part of the Cabbala Denudata & Apparatus in Lib. Sohar, p. 308 etc. Printed in Latin at Sultsbach, Anno 1677. To which is subjoyned a Rabbinical and Paraphrastical Exposition of Genesis I. written in High-Dutch by the Author of the foregoing Dialogue, first done in Latin, but now made English*, sm. 4°, 1682 (BM; not in Scholem, (2)). Henry More (1614–87) became interested by Viscountess Conway, his former pupil, who was influenced by F. M. Van Helmont: M. H. Nicolson, *The Conway Letters*, 1930.
[9] Broydé, JE, vii, 264.
[10] Thorndike, (1), ii, 99.
[11] Sarton, (1), ii, 366.

According to the *Qabbalah*, the Supreme Being, En Soph, did not create the universe directly, since it has elements of imperfection, but 'sent forth' ten Sefiroth, some male and some female, who represent parts of the Primordial or Heavenly Man. There had been worlds before En Soph assumed human form, but they were imperfect and, like sparks, died out almost at once. The universe is composed of four different worlds, each with a separate Sefiric system of ten emanations: the upper (*'aẓilutic*) World of Emanation (*'aẓilut*) and the Heavenly Man; the World of Creation (*beri'atic*), or Creative Ideas, a detailed copy of the upper world; the World of Formation (*yeẓiratic*) or of Angels (which are wrapped in luminous garments); and the World of Action (*'asiyyatic*) or of Matter, subject to change (generation and corruption) and the abode of the Evil Spirit. In the World of Formation the angels are divided into ten ranks, in charge of the sun, moon, earth, sea, fire, wind, light, the planets, the seasons, etc., with names derived from the planets which they guard; they were given special colours. The World of Action is guarded by ten demons, seven inhabiting hells and punishing sinners, their prince being Samaël (Satan).

Man is a microcosm, each part corresponding with a part of the visible universe. All souls are pre-existent in androgyne form in the World of Emanations and are allotted to bodies, from which, after death, they pass to others three times for purification, and then return to the Infinite Source. Even Satan will ultimately be restored to his angelic nature. The soul is divided into breath (*nefesh*), spirit (*ruach*), and soul proper (*neschamah*).[1] The arrangement of the ten sefiroth in the form of the human body is called a Sefirothic Tree and is usually represented without the human form as a sort of branched candelabra.

Since the letters of the Hebrew alphabet are also numbers, every word has a numerical value, representing its mysterious or 'true' meaning, and words with the same value 'explain' one another. It was believed in later times that Hebrew words had a particular power and that, since there were no writings older than the Mosaic, the Hebrew words had more occult virtue than those of other languages.[2] In actual fact, the Egyptian 'words of power' are much older than these. In some cases the name of a letter of the Hebrew alphabet is spelled out, and the numerical value of the word so formed replaces that of the letter; or the 22 letters in the alphabet are transposed (1 = 22, 2 = 21, etc.); or words are arranged in a magic square (*qāmēah*) read vertically or horizontally in both directions (these, engraved on plates of the corresponding metals were used as amulets).[3] By such devices, any system of philosophy, or anything else, may be obtained from the Bible. In old magic and Coptic texts, the Greek letters are more powerful.[4]

To express the reconciliation of opposites the idea of 'the balance' is used[5] and the elements are arranged according to weight: earth supports water,

[1] Karppe, 459. [2] Reuchlin, *De verbo mirifico*; Thorndike, (1), iv, 521.
[3] Cornelius Agrippa, *De Occulta Philosophia*, [Cologne], 1523, f. cxlv f., with talismanic figures; also in Paracelsus, *Opera*, Geneva, 1658, ii, 697; Budge, (4), 39, 45 f., 394 f.; Karppe, 285 f.; Reitzenstein, (2), 189.
[4] Wiedemann, *A. Rel.*, viii, 553. [5] Karppe, 145, 355.

water supports air, and air supports fire.[1] There are digressions on astrology and astronomy,[2] chiromancy,[3] parts of the body and medicine,[4] animals, vegetables, and trees,[5] and colours (including alchemical).[6] The ideas that 'all is one' (εἶς καὶ τὸ πᾶν),[7] of the macrocosm and microcosm and the correspondence of heavenly and earthly things,[8] and the association of the signs of the zodiac with parts of the body,[9] were all familiar earlier to the Greeks, particularly to the Neopythagoreans.[10]

Sa'adyā Gaon (A.D. 931), writing in Arabic, had commented on the relations between letters of the alphabet and the compositions of bodies. The elements (*'anāṣir*) have a certain permutation (*taqlība*) producing cold and moist etc. A study of the specific qualities (*khwāṣṣ*) of bodies gives a more subtle result; some bodies fortify their like and the cause lies in the specification (*khāṣṣiya*) of the variations in the numbers of the parts. If a body of 20 parts is composed of 5 parts of each element, this gives a specification. If each of the first two elements contains 4 parts, and each of the second two 6 parts, this gives 8 + 12 = 20, but the first two might contain 6 and the second two four, giving 12 + 8 = 20. 'This is why some specifications fortify and others weaken their like.' This is a sort of position isomerism.[11]

Although the Jews execrated the planetary gods and idolatry, they drew freely from Enoch and 'Abraham' the rules for deciphering these celestial phenomena.[12] Much of the so-called 'Practical Qabbalah', dealing with charms, amulets, spells, occult medicine, etc., is mere superstition; it exists only in manuscripts. The amulets and talismans have triangles, pentacles, crude figures (including phallic), and symbols of the planets quite different from the common ones.[13] There was also a belief in the evil eye.[14] A Hebrew *Book of the Key of Solomon* (Sefer Mafteaḥ Shaloms; *Clavicula Salamonis*), which was mentioned previously is a commonplace work of vulgar superstition. The *Book of Arbatal*, printed with works attributed to Cornelius Agrippa[15] is a modern fabrication which was first printed at Basel in 1575.[16] It divides the firmament into 196 regions ruled over by seven supreme angels, whose 'seals' are given:

(1) Aratron, the alchemist, who could transmute metals; (2) Bethor; (3) Phaleg; (4) Och the alchemist, who could change everything into gold and precious stones, and perfected the science of medicine; (5) Hagith, ruling over matters connected with Venus, could transmute gold into copper and copper into gold; (6) Ophiel dealt with everything connected with Mercury and could transmute quicksilver into a white stone; (7) Phul, lord of the powers of the Moon, could transmute anything and everything into silver.

1 *Ib.*, 149, 207. 2 *Ib.*, 510 f. 3 *Ib.*, 330, 506 f. 4 *Ib.*, 391, 393, 517 f.
5 *Ib.*, 394, 552 f. 6 *Ib.*, 137, 173, 408, 419 f., 421. 7 *Ib.*, 404, 414.
8 *Ib.*, 51, 76 f., 84, 89, 171, 184, 274, 336, 353, 377, 452, 467, 522. 9 *Ib.*, 155.
10 Farbridge, 20, 93, 97 f., 123; Holtzmann, *A. Rel.*, xxiv, 126.
11 Kraus, (2), 269.
12 Bouché Leclercq, 600.
13 L. Blau, JE, i, 546 (amulet); Budge, (4), 218, 225, 373, 386 f., 394; Ginsburg, (1), 1920, 183, 195; Grillot de Givry, 95 f., 104 f. (18-cent. MSS. in Bibliothèque de l'Arsenal, incl. 'Les vrais Clavicules du roy Salomon, traduitte de l'hébreu par Armadel', with diagrams); B. Heller, *E. Jud.*, ii, 737 (Amulette).
14 L. Blau, JE., v, 280.
15 H. C. Agrippa . . . *Operum Pars Posterior* . . . , Lugduni. Per Beringos Fratres, 1600 (?), 574.
16 Budge, (4), 386; Thorndike, (1), vi, 457.

Vincent of Beauvais (see p. 243) had included Adam, Noah, and Moses among the alchemists,[1] but the alchemical work *Esh Mezaref* (Purifying Fire) attributed to Sa'adyā Gaon al-Fayyūmī (A.D. 882–931 or 942)[2] is a late forgery.[3] The *Qabbalah* had been related to alchemy by Paracelsus.[4] The *Esh Mezaref* relates the colours of metals to the Sefiroth and the points of the compass, and the numerical values of names of the metals to those of the planets. It says[5] gold is the ornament (*hered* = 5 + 200 + 4 = 209) of the mineral kingdom as Yahveh (10 + 5 + 6 + 5 = 26) is the ornament of the world of spirits. But 26 × 8 = 208, and adding 1 for the word itself, this is 209. *Jesod*, foundation, also means mercury, the foundation of the art of transmutation. The nature of mercury is indicated by the name *alhy* (= 1 + 30 + 8 + 10 = 49), 'living god'. But what mystery is attached to the word *kokab* (20 + 6 + 20 + 2 = 48) and star (48 + 1 = 49)? 'The character of true mercury is to become covered by the action of heat with a pellicule approaching more or less to the colour of gold, and this can occur even in the course of a single night (when the star shines); hence the mystery indicated by the name *kokab*, star.'

By replacing *al* = 31 in *alhy* = 49 by *kesef* = 160, silver, one obtains *kesef hy* = 160 + 18 = 178, the same as 160 + (49 − 31), meaning quicksilver or mercury. Mercury is called by various names: spherical water, water of immersion or purification, or water of gold.[6] Similar numerical relations are given for the other metals in a way which is not clear to me. Celestial gold gives seven kinds of terrestrial gold of seven colours, three above and four below.[7]

The metals are composed of sulphur and mercury, and mercury is the basis of the art of transmutation (argentum vivum est fundamentum totius artis transmutatoriae).[8] There are unintelligible accounts of the preparation of sublimates[9] from the calx of gold and the calx of silver and red silver ore, the mixtures being strongly heated in a phial put in sand, 'according to R. Mordechai', from some Arabic source (et conferantur haec cum scriptis Philosophi Arabis). The accounts of tin,[10] iron,[11] antimony,[12] sulphur,[13] gold,[14] copper,[15] and lead,[16] connecting them with the planets, are purely mystical, and the whole work is devoid of any chemical interest.

In Jewish literature silver (masculine, white, on the right side) comes before gold (feminine, red, on the left side); in some cases the 'natural' order gold-silver is contrasted as a 'reflection' of the 'spiritual' order silver-gold, of the upper and lower worlds. The *Zohar* has seven kinds of 'theosophical gold'.[17]

[1] *Speculum Naturale*, bk. vii, c. 87; Venice, 1494, 79*v*.

[2] Knorr von Rosenroth, *Kabbala Denudata*, 1677, i, 155–570; *A Short Enquiry concerning the Hermetick Art, address'd to the Studious therein. By a Lover of Philalethes. To which is annexed a Collection from Kabbala Denudata and Translation of the Chymical-Cabbalistical Treatise*, intituled, *Aesch-Mezareph*, or *Purifying Fire*, sm. 8°, 1714.

[3] Hoefer, (1), i, 247; Karppe, 515; Kopp, (4), ii, 232 f.; Waite, (3), 377 f. (from a '16 cent. Aramaic original', unknown).

[4] *De tinct. physicor.*, c. 2; *Opera*, 1658, ii, 117.

[5] Rosenroth, i, 441–2; Hoefer, (1), i, 248.

[6] Rosenroth, i, 441–2; Hoefer, (2), i, 248.

[7] Rosenroth, i, 298 f.

[8] *Ib.*, i, 441.

[9] *Ib.*, i, 483.

[10] *Ib.*, 184.

[11] *Ib.*, 206.

[12] *Ib.*, 207.

[13] *Ib.*, 241.

[14] *Ib.*, 298 f.

[15] *Ib.*, 570.

[16] *Ib.*, 625.

[17] G. Scholem, Alchemie und Kabbala, in *Monbtssbhrift für Ges:hibhte und Wissenschaft des Judentums*, Frankfurt, 1924, lxix, 13–30 (23–5); *ib.*, 371–4; R. Eisler, *ib.*, 364–71.

The seven metals (including mercury) are connected with the 7 sefiroths and 7 planets by Chajim Vital (d. 1622) in the order silver, gold, copper, tin, lead, mercury, iron.[1] Scholem thought alchemy was foreign to the true *Qabbalah*, but admits some in the *Zohar*;[2] the 'great work' [of marking gold and silver] in Moses Shem-Ṭob (1250–1305) is interpolated. In the table of comparisons:

	fire	water	wind	earth
primary metals	gold	silver	copper	iron
secondary metals	brass	lead	tin	iron (steel ?)

the secondary metals are supposed to be formed of the primary and earth.[3]

The *suspitha* gold in the *Zohar* was translated 'slag of gold',[4] but Eisler[5] read *sussipta*, 'putrefied' (συσσηπτή) gold', the 'black mass' (τέλειον μέλαν) or primary matter described by the Greek alchemists, which by the action of the 'ferment' became red copper, white silver, and yellow gold. Simon ibn Labi (d. 1560), who came to Tripoli from Morocco, where Jews were then practising alchemy, thought gold is silver 'ripened' in the earth by the sun, and electrum (silver + gold) is only half-ripe.[6]

Hebrew alchemical MSS. are late, have been inadequately described, and are apparently of little interest.[7] Some have illustrations of apparatus, especially for distillation.[8] Judah ha-Levi (b. Toledo *c.* 1085) in a philosophical treatise originally written in Arabic, *Kitāb al-Khazāri*,[9] mentions alchemy. Maimonides (1135–1204) mentions the writings attributed to Hermes in his account of the Ṣābians. Gershon ben Solomon in his *Sha'ar ha-Shamayim* (*c.* A.D. 1280), based on Hebrew translations of Greek and Arabic works, has an account of *al-kiminiya*.[10] There is a Hebrew translation of Abū'l Qasīm al-Majriti's *Aim of the Wise* (10 cent.), which is in a Munich MS. Gaster[11] possessed a Hebrew alchemical MS. written in 1690 in Morocco or Italy. The first part uses Greek and Arabic sources, and has a glossary of Greek and Arabic words, the second mediaeval Latin. It contains excellent drawings of apparatus resembling those in Greek MSS. It is free from magic symbolism. Gaster thought it a copy of an original of 1300 to 1450 A.D. It cites many authorities, some otherwise unknown, but many names are much disfigured; e.g. Ashprmanatt = Johannes Archipresbyter (Archiprètt), Sasiton = Ostanes, Humash = Hermes, Aliberto Manyo = Albertus Magnus, Irimanus of Konstantina = Morienus; Piero Dabano is probably not Petrus Bonus, as Gaster thought, but Peter of Abano (1250–1318). Other names are Srop, Yeber, Arcturus, the Pope, Plato, Razis, etc., some perhaps from the *Turba*.

[1] Scholem, 28. [2] Karppe, 503–4, 515; Scholem, 21. [3] Scholem, 21.
[4] Scholem, 26, 371. [5] *Op. cit.*, 364. [6] Scholem, 28–9.
[7] Gaster, (1), (2); B. Suler, *E. Jud.*, ii, 137–59.
[8] Underwood, *Trans. Inst. Chem. Eng.*, 1935, xiii, 34 (41): 14 cent.
[9] Sarton, (1), ii, 186. [10] Gaster, (2); Sarton, (1), ii, 886. [11] (2), 332.

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